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Willow Run Airport
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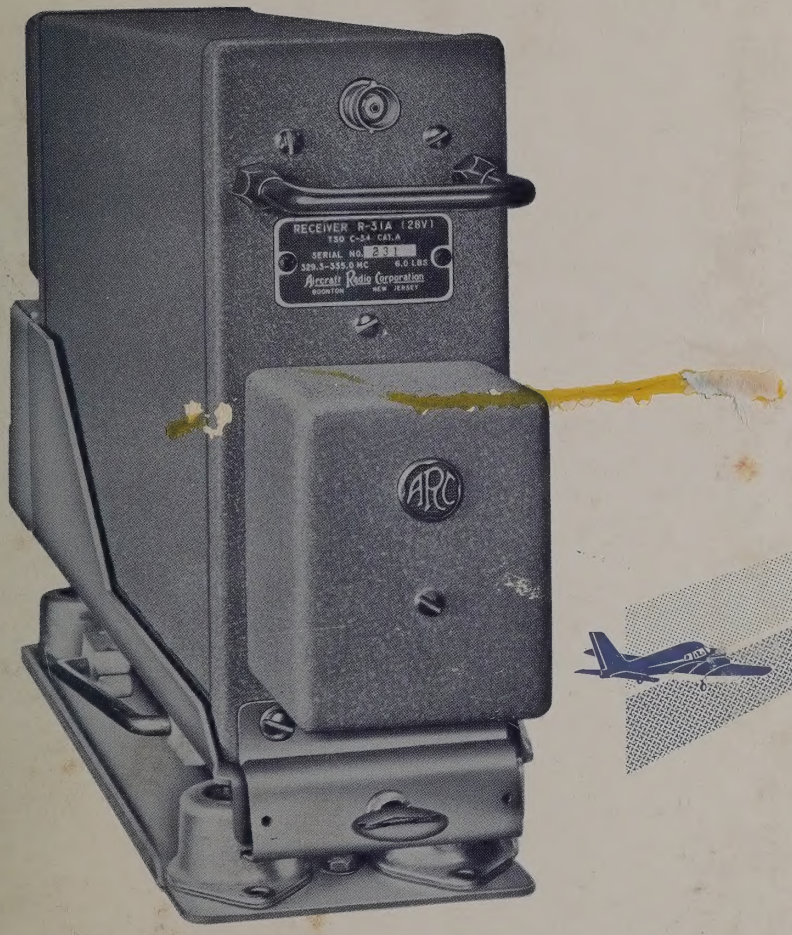
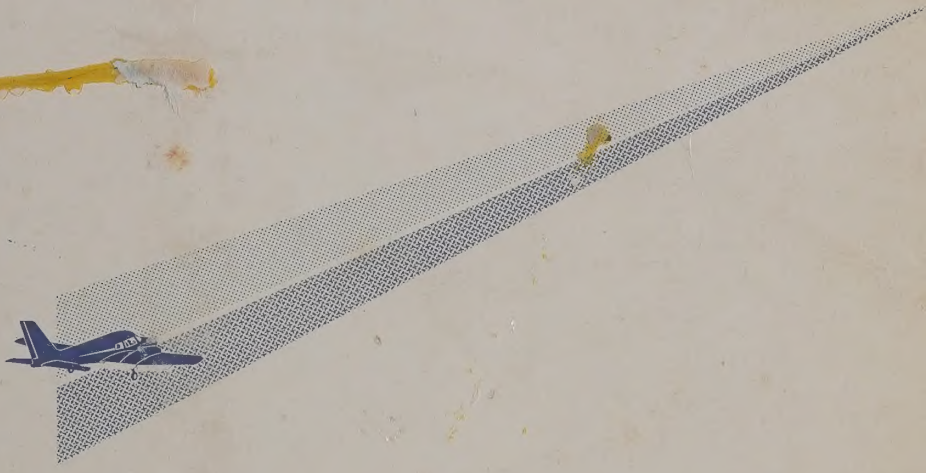
Ypsilanti, Michigan

arc type R-31A

GLIDE SLOPE RECEIVER





ARC

Aircraft Radio Corporation
BOONTON, NEW JERSEY

arc type R-31A

GLIDE SLOPE RECEIVER

Aircraft Radio Corporation
BOONTON, NEW JERSEY

7010126
ARCIB-R31A-2
March 1961
Printed in U.S.A.

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The information in this instruction book does not profess to include all the details of design, production, or variations of the equipment, or to cover all the possible contingencies which may arise during operation, installation, or maintenance. Should special problems arise or further information be desired, contact the Technical Services Department of Aircraft Radio Corporation.

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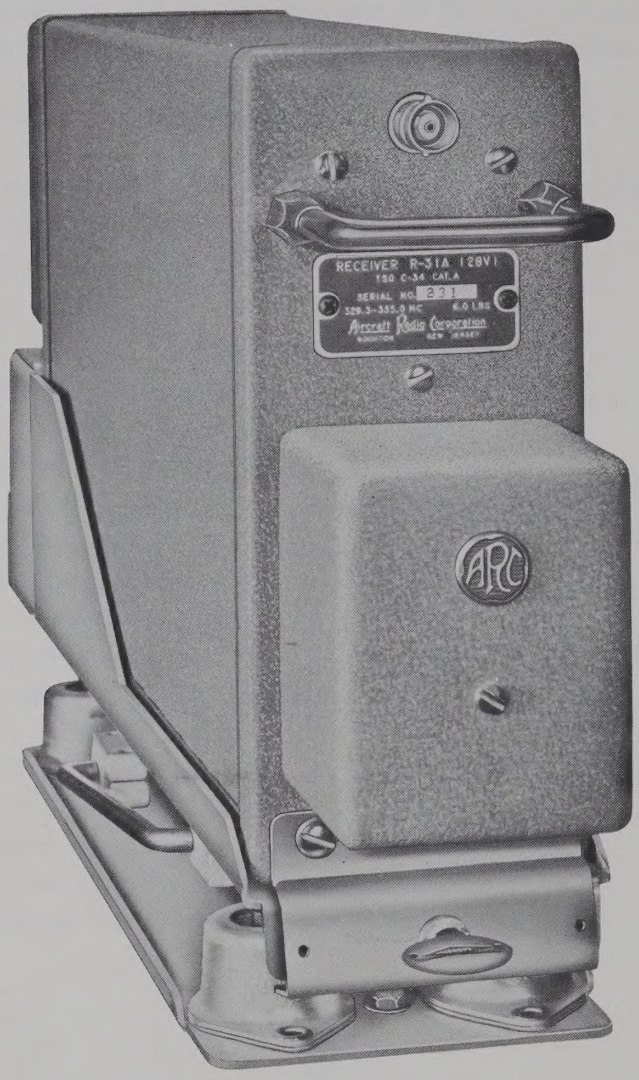

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Figure 1–1. ARC Type R-31A Receiver with ARC Type M-41A Mounting

SECTION I
GENERAL INFORMATION

1–1. INTRODUCTION.

This instruction book contains installation, operation, principles of operation, and maintenance information for the ARC Type R-31A Glide Slope Receiver, manufactured by Aircraft Radio Corporation, Boonton, New Jersey.

1–2. PURPOSE.

The R-31A Receiver is designed to receive ILS glide-slope signals and convert them to voltages which actuate the horizontal pointer of a deviation indicator. The horizontal pointer shows the aircraft position relative to the glide slope. The R-31A is used with localizer receiving equipment such as the ARC Type 15F VHF Navigation Equipment.

1–3. SPECIFICATIONS.

Receiver Type:	Double-conversion superheterodyne
Frequency Coverage:	329.3 through 335.0 mc
Tuning:	Crystal-controlled, remote, eleven-wire channel selection
Number of Channels:	20
Channel Spacing:	300 kc
Channeling Time:	2 seconds, maximum
Sensitivity:	40 μv or less of standard signal for 47-μa deflection
Bandwidth:	6 db down, 120 kc bandwidth; 60 db down, 530 kc bandwidth
Spurious Response:	Greater than 60-db attenuation
Radiation:	Negligible
Automatic Gain Control:	3-db output variation for 80-db input change
Input:	50 ohms nominal impedance
Output:	Designed for standard deviation indicator
Cross Modulation:	Greater than 40-db rejection
Course Sensitivity:	Adjustable, factory set for 78 μa with 2-db ratio (90-cps modulation predominant) and input of 700 μv
Input Power:	0.7 ampere at 27.5 volts dc; 1.5 amperes at 13.75 volts dc
Tube Complement:	5718 Tripler 5899 R-f Amplifier 5899 First Mixer 5899 First I-f Amplifier 6021 First Crystal Oscillator-Doubler
Transistor Complement:	2N384 Second Crystal Oscillator 2N384 Second Mixer 2N274 First 1.7-mc I-f Amplifier 2N274 Second 1.7-mc I-f Amplifier 2N274 Third 1.7-mc I-f Amplifier 2N274 Fourth 1.7-mc I-f Amplifier 2N274 Signal Detector 951 First A-f Amplifier 2N375 Second A-f Amplifier 2N1150/904 Agc Detector-Amplifier 2N1150/904 Agc Amplifier 2N375 High-voltage Multivibrator 2N375 High-voltage Multivibrator
Diode Complement:	1N462 Agc Clamp 1N1351A 10-volt Zener Rectifier 1N2071 Rectifier 1N2071 Rectifier 1N1358RA –20-volt Zener Rectifier 1N118 (8) Dual-bridge Rectifier 1N462 (2) Dual-bridge Rectifier
Indicating System:	Will operate two 1000-ohm deviation indicator movements and an autopilot connection in parallel, or equivalent, and two 1000-ohm flag movements in parallel
Mounting:	ARC Type M-41A Mounting for single-unit installation; or other ARC Series 40 Mounting for multiple-unit installation
Weight:	6.0 pounds, less mounting; 7.4 pounds, including single-unit mounting
Dimensions:	3 7/32 in. wide, 7½ in. high, 14½ in. long over-all, including single-unit mounting
Certification:	FAA TSO C-34, Category A

1–4. EQUIPMENT SUPPLIED.

The unit and accessories supplied for an R-31A installation are listed in Table 1–1. The R-31A and the M-41A Mounting are shown in Figure 1–1.

TABLE 1–1. EQUIPMENT SUPPLIED

Qty	Name	ARC Part No.
1	Receiver ARC Type R-31A[1]	21422
1	Connector Kit consisting of:	22443
1	Connector	21983
1	Plate	22627
6	Sems, fillister head, No. 4-40, ¼ inch long, split lockwasher	524-0016
2	Screw, machine, flat head, No. 6-32, 5/16 inch long	146-0020
2	Stud, snapslide	22237
2	Connector, coaxial (UG-88C/U)	11337
1	Instruction Book	7010126

[1] The R-31A is supplied in either a 14-volt or 28-volt model.

1–5. UNITS AND ACCESSORIES REQUIRED BUT NOT SUPPLIED.

Table 1–2 lists the units and accessories required, but not supplied, for installation and operation of the R-31A Receiver. In addition to the items listed, a cable assembly must be fabricated from individual wires (not supplied), the connector in Connector Kit ARC-22443, and the connector supplied with the selected control unit. The recommended wire sizes for the cable assembly are shown in Figures 2–10, 2–11, and 2–12. The length of the cable will depend on the location of the equipment in the aircraft. The R-31A requires a primary power source capable of supplying 0.7 ampere at 27.5 volts dc or 1.5 amperes at 13.75 volts dc, depending on the voltage rating of the equipment.

1–6. DESCRIPTION OF R-31A RECEIVER

The R-31A Receiver is a glide-slope receiver covering the frequency range of 329.3 through 335.0 mc in 20 channels spaced 300 kc apart. An eleven-wire system is used to select the proper frequency from a standard ARINC control unit, such as ARC Type C-69A, C-88A, or CC-12A. The receiver is a double-conversion superheterodyne using one of ten crystals for the fundamental of the first injection frequency and one of two crystals for the second injection frequency. With the exception of the front-mounted antenna connector, all connections to the R-31A are made through a single connector mounted on the rear of the chassis. The unit requires approximately 0.7 ampere when a 28-volt primary power source is used and 1.5 amperes when a 14-volt primary power source is used.

Physically, the R-31A consists of seven assemblies which are supported and interconnected by a main chassis.

TABLE 1–2. UNITS AND ACCESSORIES REQUIRED BUT NOT SUPPLIED

Qty	Name	ARC Type No.	ARC Part No.
1	Antenna[1]	A-13B	15823
		A-326A	25070
1	Control Unit[2]	C-69A	21700
		C-88A	22500
		CC-12A	22970
AR	Cable, coaxial (RG-58/U)	—	11318(*)[3]
1	Course Indicator[4]	IN-10	16706
		IN-14	18028
1	Mounting[5]	Series 40	—

[1] The A-13B is used for simultaneous reception of VOR and glide-slope signals. The A-326A is used for glide-slope reception only.
[2] The C-69A and C-88A are edge-lighted units for use in aircraft having console mounting facilities. The C-69A is used for selection of glide-slope frequency only and contains an on-off switch and a selector switch. The C-88A is used to control the R-31A Receiver when it is used with ARC Type 15F VHF Navigation Equipment; the associated glide-slope frequency is automatically selected when a localizer frequency is selected. In place of the C-88A, a custom installation may be made using ARC Type CC-12A Custom Control Unit.
[3] In place of asterisk (*), cable length in feet and inches is specified to complete part number; for example: 11318-0905 for a 9 ft. 5 in. cable.
[4] Either the IN-10 or IN-14 may be used for presentation of glide-slope information. The IN-10 is normally supplied with the associated ARC Type 15F VHF Navigation Equipment. If an ARC Type CD-1, CD-2, CD-3, or CD-4 Course Director is used in addition to the Type 15F, an IN-14 is used.
[5] For single-unit installation, use an ARC Type M-41A Mounting (ARC-21790).

Five of the assemblies (preselector, A1; first i-f, A2; second i-f, A3; af-agc, A4; and meter, A5) are mounted inside the aluminum dust cover for the main chassis. The other two assemblies (channel selector, A6, and high-voltage supply, A7) are mounted externally. The main chassis consists of an aluminum alloy frame to which the front panel is attached; a ten-position, two-section, rotary switch; a crystal drum; a printed-circuit connector board; and three connectors. All connections, parts, and wiring common to the assemblies are also located on the main chassis. With the exception of preselector assembly A1, all internal assemblies are similar in construction. They consist of an aluminum alloy frame and a printed-circuit board. The board and the aluminum alloy frame provide a mount for the electrical parts. Each plug-in assembly is secured to the main chassis by two flat head screws.

The radio frequency circuits (329.3 – 335.0 mc) are contained in preselector assembly A1. This assembly employs four subminiature electron tubes serving as r-f amplifier, mixer, oscillator-doubler, and tripler. One other electron tube in the first i-f assembly provides amplification of the first intermediate frequency. All other stages in the receiver are transistorized. The major portion of the gain in the receiver is supplied by a relatively nonselective transistor i-f amplifier having a 60-db gain. The primary selectivity of the receiver is obtained from two hermetically sealed filter units. One of the filter units is contained in first i-f assembly A2 and the other in

second i-f assembly A3. The emitter circuits of the second 1.7-mc i-f amplifier A3Q2, agc detector-amplifier A4Q1, and agc amplifier A4Q2 use temperature-sensitive resistors to provide high stability with wide variations in temperature.

1–7. DESCRIPTION OF ASSOCIATED UNITS.

Antennas. The ARC Type A-13B Antenna is a "ramshorn" antenna with two dipoles. The forward dipole is used for glide-slope signal reception. The V-shaped rear dipole is used for reception of VOR and other signals. Each antenna is terminated with a UG-291/U coaxial connector, located in the antenna base. The dipoles are set in a rubber block, which in turn is fastened to an aluminum pedestal support. The A-13B is designed for mounting on any relatively flat portion of the aircraft structure. The pedestal support has two 1/16-inch radius drainage tunnels at its base that permit the escape of accumulated moisture when the A-13B is mounted in an upright position. When the A-13B is mounted in an inverted position, it is necessary to drill through the white-marked, 5/32-inch diameter depression in the top of the rubber block to provide for moisture drainage.

Caution

Drill through the rubber only. The antenna will be damaged if the drill penetrates too deeply.

The ARC Type A-326A Antenna is a dipole used for reception of glide-slope signals. The A-326A is designed for installation in the windshield area inside the aircraft. The antenna is built around a drawn, nickel-plated brass can that houses a 10-$\mu\mu$f ceramic capacitor and the interconnecting wires. The capacitor and the wires form a balun that matches the impedance of the antenna to the input impedance of the R-31A. Each of the two detachable antenna elements is screwed to a threaded terminal that protrudes through the side of the can. Three mounting flanges on the can are used for securing the unit to the mounting surface. A UG-290A/U coaxial connector is used to terminate the antenna.

Control Units. The ARC Type C-69A Control Unit is used for independent control of the R-31A Receiver. A twenty-position, rotary, channel selector switch mounted on the front of the control unit is used to select the desired glide-slope frequency. The toggle switch mounted adjacent to the channel selector switch applies power to the R-31A. Four midget, flange-base lamps are installed in red-filter light assemblies on the front panel. The light from these lamps is transmitted through translucent areas on the front panel, permitting easy identification of the controls and their settings.

The ARC Type C-88A Control Unit is used for simultaneous control of the R-31A and the ARC Type 15F VHF Navigation Equipment. When the C-88A is positioned to an odd-tenth-megacycle localizer frequency, control circuits within the control unit automatically tune the R-31A to the glide-slope frequency paired with the selected localizer frequency. Edge-lighting of the C-88A is provided by two midget, flange-base lamps installed in red-filter light assemblies on the front panel.

The ARC Type CC-12A Custom Control Unit is used in custom installations to perform the automatic switching and channel selection functions of the C-88A.

Indicators. The ARC Type IN-10 Course Indicator is a combined deviation indicator, course selector, and to-from meter. The deviation indicator is a special type of microammeter with two pointer mechanisms and two flag mechanisms for indicating the operating or nonoperating condition of the pointers. The horizontal pointer indicates the glide-slope information received from the R-31A. It is pivoted at the left and moves up and down to indicate the aircraft position with respect to the on-course signal of the glide-slope transmitter. The vertical pointer is pivoted at the top and moves left or right. This pointer is used with a localizer receiver to show the relation of the aircraft to the localizer beam. A red flag is associated with each pointer. The horizontal pointer flag indicates the presence or absence of proper output signals from the R-31A.

Externally, the ARC Type IN-14 Course Indicator is identical to the IN-10, and performs the same functions as the IN-10. Internally, the IN-14 contains a synchro transmitter which is used with the ARC Type CD-1, CD-2, CD-3, or CD-4 Course Director.

Mounting. The ARC Type M-41A Mounting, or other ARC Series 40 Mounting, is used to shock-mount the R-31A Receiver and to provide a means of making electrical connections to the unit. The R-31A is secured by an adjustable flange located at the front of the mounting. Two flexible metal straps located on the underside of the mounting are used to ground the R-31A and M-41A to the airframe. Eight No. 6 screw holes are provided in the bottom plate of the M-41A for securing the mounting.

Note

If the R-31A is to be installed with other ARC modular-type units, one of the multiple-unit ARC Series 40 Mountings may be used. For detailed information, refer to the instruction book for the ARC Series 40 Mountings.

1–8. GLIDE-SLOPE FREQUENCY ALLOCATIONS.

The FCC has allocated the frequency band of 328.6 through 335.4 mc for the transmission of glide-slope information. Within this band there are 20 glide-slope frequencies spaced 300 kc apart. The band is divided into four frequency groups related to the 108-, 109-, 110-, and 111-mc localizer bands. In each group, five glide-

slope frequencies are paired with specific localizer frequencies as listed in Table 1–3.

When the C-88A Control Unit or CC-12A Custom Control Unit is used, the R-31A is automatically tuned to the glide-slope frequency paired with the selected localizer frequency. When the C-69A Control Unit is used, the glide-slope frequency must be individually selected by positioning the C-69A channel selector switch.

Though, at present, only ten glide-slope frequencies are active, the R-31A is designed and wired to receive all allocated frequencies.

TABLE 1–3. LOCALIZER AND GLIDE-SLOPE FREQUENCIES

Localizer Frequency	*Glide-slope Frequency*
108.1	334.7
108.3	334.1
108.5	329.9
108.7	330.5
108.9	329.3
109.1	331.4
109.3	332.0
109.5	332.6
109.7	333.2
109.9	333.8
110.1	334.4
110.3	335.0
110.5	329.6
110.7	330.2
110.9	330.8
111.1	331.7
111.3	332.3
111.5	332.9
111.7	333.5
111.9	333.1

SECTION II

INSTALLATION

2–1. UNPACKING.

Carefully unpack the R-31A and accessories. Inspect the shipment for damage, and check off the items received against the packing slip and list of equipment supplied (Table 1–1).

2–2. CABLE FABRICATION.

The interconnecting cable assembly used to interconnect the R-31A, the control unit, and the deviation indicator must be fabricated from individual wires. The ARC-21983 connector required for the cable is supplied, but the individual wires and other connectors are not. An open-wire cable is recommended because of its flexibility, ease of construction, and facility of repair. The antenna cable assembly is fabricated from a length of RG-58/U coaxial cable (not supplied) and the two UG-88C/U connectors (supplied). The final length of the cable assemblies will depend on the location of the units in the aircraft. System interconnecting diagrams are shown in Figures 2–10, 2–11, and 2–12. Instructions for fabricating the antenna cable assembly are given in Figure 2–3.

2–3. PREINSTALLATION TEST.

Before installing the R-31A Receiver, bench-test the unit as follows:

Step 1. Fabricate the interconnecting cable assembly illustrated in Figure 2–10 using the connectors and type of wire noted. Interconnect the R-31A Receiver, C-69A Control Unit, IN-10 Course Indicator, and the low-voltage power supply.

Step 2. In place of the A-326A Antenna shown in Figure 2–10, connect the RF OUTPUT connector of a Boonton Radio Corp. Model 232-A Glide Slope Signal Generator.

Step 3. Turn the equipment on.

Step 4. For each channel, adjust the signal generator for a standard, 700-μv on-course signal and check that the horizontal pointer of the course indicator centers for an on-course signal and that the flag disappears.

Step 5. For each channel, adjust the signal generator for a standard, 700-μv, 2-db off-course signal (90-cps modulated signal predominant) and check that the horizontal pointer deflects downward slightly more than two dots and that the flag disappears.

Step 6. Use the signal generator DB TONE RATIO switch and check that the flag is in full view when either the 90-cps or the 150-cps modulation signal is removed.

2–4. INSTALLATION REQUIREMENTS.

The following requirements are applicable to all installations of the R-31A.

Location of Units. Compare the installation area under consideration with the applicable dimensions shown on Figures 2–1 through 2–9. Locate the R-31A in an area that is accessible for maintenance and inspection, and reasonably free from excessive vibration and heat. Mount the C-69A, C-88A, or CC-12A and the IN-10 or IN-14 on the instrument panel within convenient view and reach of the operator.

Antenna. The R-31A requires a 50-ohm antenna. If the R-31A is used with ARC Type 15F VHF Navigation Equipment, the glide-slope antenna that is part of the ARC Type A-13B Antenna is used. If a separate glide-slope antenna is necessary, an ARC Type A-326A Antenna is used. The A-326A is designed for installation in the windshield area inside the cockpit.

External Wiring. Figures 2–10, 2–11, and 2–12 are interconnection diagrams of the external wiring associated with the R-31A. Wires should be tied or laced and supported as required after interconnection. Sufficient slack should be left to allow removal of the R-31A for adjustment with wires connected. Assembly instructions for the antenna cable assembly are shown in Figure 2–3. The R-31A requires d-c power at the voltage indicated on the nameplate (14 volts or 28 volts). Connection to the power source should be made through a switch and a circuit-protective device, located as desired.

2–5. INSTALLATION OF R-31A RECEIVER AND M-41A MOUNTING.

The R-31A Receiver is designed for individual installation on an M-41A Mounting or with other ARC modular units on an ARC Series 40 multiple-unit mounting. Installation dimensions for the R-31A installed on an

M-41A are shown in Figure 2–1. External wiring to the R-31A is accomplished with an ARC-21983 connector. This connector with the necessary parts and attaching hardware is part of Connector Kit ARC-22443. As shipped, the connector contacts are separate from the body of the connector. Wire the connector and mount the M-41A and R-31A as follows:

Step 1. Drill the aircraft mounting surface for eight No. 6 binding head screws, located as shown in Figure 2–1.

Note

The bottom plate of the M-41A can be used as a template for locating the mounting holes.

Step 2. Insert the screws through the eyelets attaching the shock mounts to the lower plate and place the M-41A in position. Secure with nuts and lockwashers. The mounting surface should be clean, bare metal to insure adequate grounding of the unit.

Step 3. Remove the coupling box from the rack assembly and then remove the top cover from the coupling box.

Step 4. Using the six ARC-524-0016 fillister head Sems screws furnished, attach the ARC-21983 Connector to the ARC-22627 Plate as shown in Figure 2–2.

Step 5. Cut the wires necessary to form the interconnecting cable. The length of the wires depends on the type of aircraft and the proposed location of the unit. If possible, use color-coded wires to simplify future maintenance of the interconnected units.

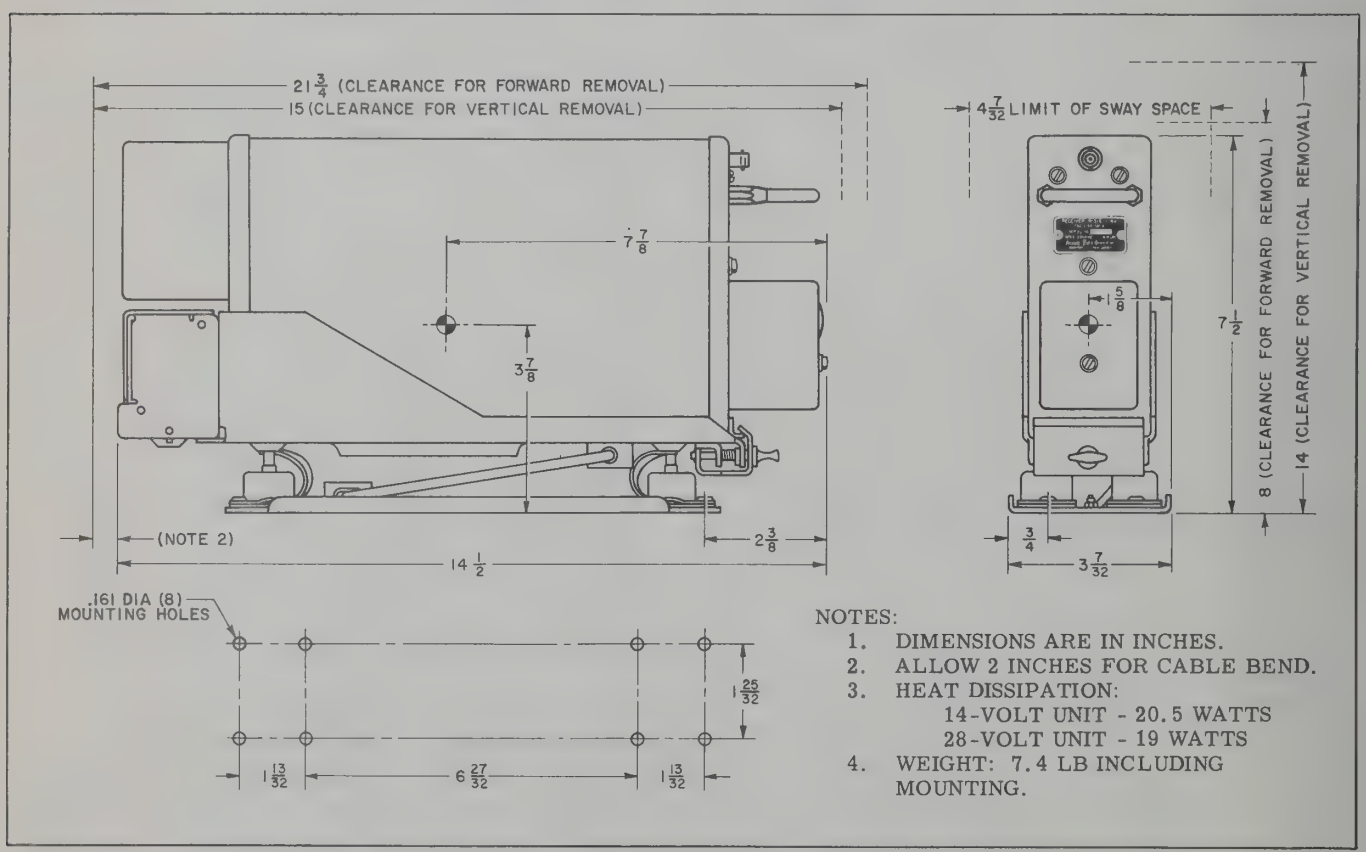
Step 6. Remove the insulation from the ends of each wire, then tin the bared ends.

Step 7. Solder connector contacts to the wires to be terminated in the connector (see Figure 2–10, 2–11, or 2–12). Do not get solder on the outside of the contacts.

Note

Contacts in Connector Kit ARC-22443 are supplied loose. Contacts for holes designated with letters are larger than those contacts intended for holes designated with numbers. To remove the contacts from the connector, use ARC-22001 and ARC-22002 Contact Removing Tools. If desired, the connector may be used as a holding fixture by inserting the contacts part way before soldering wires to them.

Step 8. Loosen the two screws holding the cable clamp to the coupling box. Route the contacts and attached wires through the cable clamp and then insert the contacts in the appropriate connector holes. Make sure that each contact is seated.



TP1675

Figure 2–1. R-31A Receiver with M-41A Mounting, Installation Dimensions

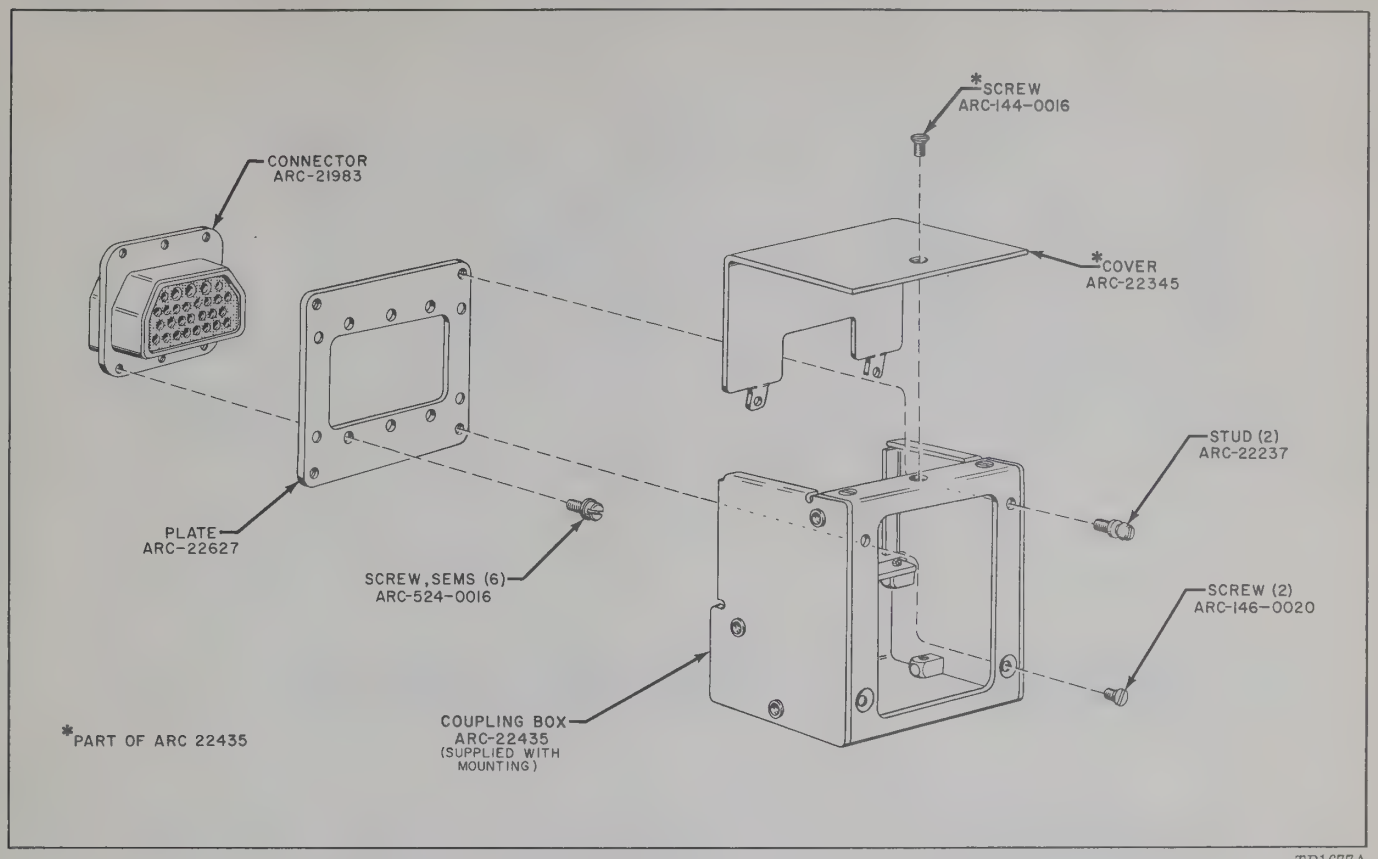


Figure 2–2. Assembly of Connector, Plate, and Coupling Box

Step 9. Arrange the wires allowing enough slack to prevent tension on the connector contacts when the cable clamp is tightened. Tighten the cable clamp and then replace the top cover on the coupling box.

Step 10. Attach the two ARC-22237 snapslide studs to the coupling box as shown in Figure 2–2. Place the coupling box on the rear of the M-41A. Secure the coupling box by engaging the two snapslide fasteners on the M-41A with the snapslide studs on the coupling box.

Step 11. Loosen the thumbscrew on the front of the M-41A and slide the R-31A in place so that the R-31A connector fully engages the mating connector on the coupling box. Secure the R-31A by engaging it with the clamp at the front of the tray and tightening the thumbscrew. Safety-wire the thumbscrew in position.

Step 12. Connect the antenna cable assembly to the antenna connector on the front panel of the R-31A.

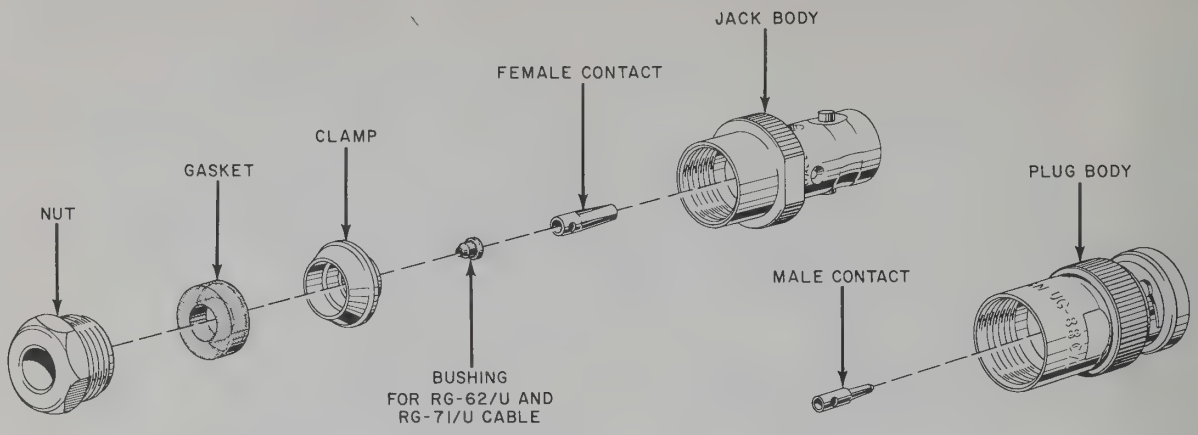
2–6. INSTALLATION OF CONTROL UNIT.

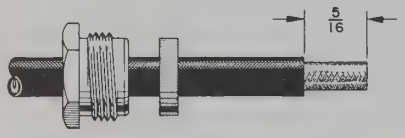
The ARC Type C-69A Control Unit is used to control the R-31A Receiver only; the ARC Type C-88A Control Unit is used for automatic control of the R-31A when it is used with ARC Type 15F VHF Navigation Equipment. Each of these units is designed for installation in a standard AN console panel. Four Dzus fasteners are used to secure the control unit to the console. Installation dimensions for the C-69A and C-88A are shown in Figures 2–4 and 2–5, respectively.

The ARC Type CC-12A Custom Control Unit is used to simultaneously control the R-31A and the Type 15F in custom installations. Installation dimensions for the CC-12A are given in Figure 2–6. The method of mounting the custom control unit will vary, depending on the thickness of the metal mounting plate and whether a 3/16-inch edge-lighted plastic panel is used in front of the metal panel. Assembly details for the CC-12A are shown in Figure 2–7. Wiring information for the custom installation is given in Figure 2–12.

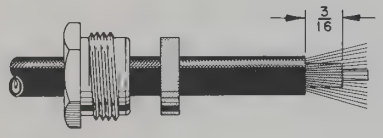
2–7. INSTALLATION OF A-326A ANTENNA.

Installation dimensions for the A-326A Antenna are shown in Figure 2–8. The A-326A is designed for mounting in the windshield area inside the cockpit. The exact location and method of installation will depend on the aircraft in which it is to be installed. Since the final position of the antenna can affect the over-all performance of the R-31A, observe the following recommendations:

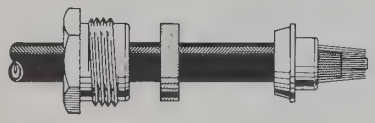




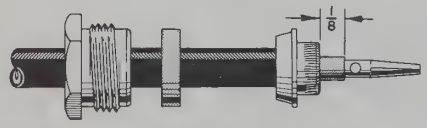
PLACE NUT AND GASKET OVER CABLE AND TRIM JACKET TO DIMENSION SHOWN. UNGROOVED FACE OF GASKET MUST BE TOWARD NUT.



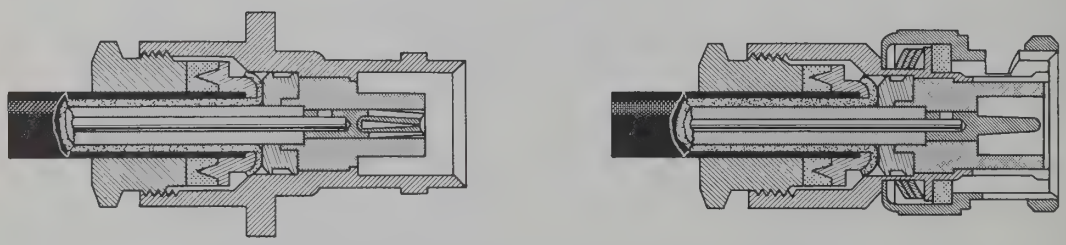
COMB OUT BRAID AND CUT CABLE DIELECTRIC TO DIMENSION SHOWN, BEING CAREFUL NOT TO NICK CENTER CONDUCTOR. TIN CENTER CONDUCTOR.



PULL BRAID WIRES FORWARD AND TAPER TOWARD CENTER CONDUCTOR. PLACE CLAMP OVER BRAID AND PUSH AGAINST CABLE JACKET.



FOLD BACK BRAID WIRES AS SHOWN, TRIM TO PROPER LENGTH, AND FORM OVER CLAMP AS SHOWN. FOR RG-62/U AND RG-71/U CABLE, SLIP BUSHING OVER CENTER CONDUCTOR AND UNDER DIELECTRIC. SOLDER CONTACT TO CENTER CONDUCTOR.



INSERT CABLE AND PARTS INTO CONNECTOR BODY. MAKE SURE SHARP EDGE OF CLAMP SEATS PROPERLY IN GASKET. TIGHTEN NUT.

TP1731

Figure 2–3. Fabrication of Antenna Cable Assembly

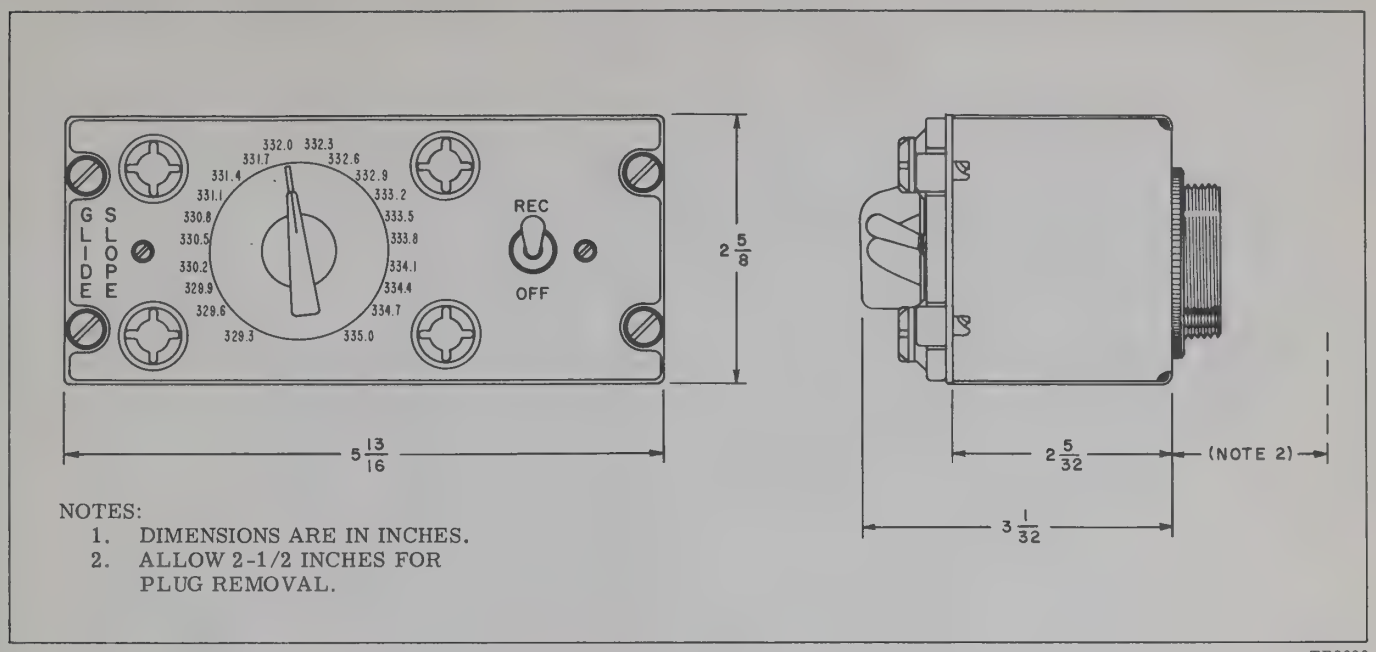


Figure 2–4. C-69A Control Unit, Installation Dimensions

1. If possible locate the antenna elements at least 8 inches from the nearest ground plane. In any case, do not locate the antenna elements less than 6 inches from the nearest ground plane.

2. If possible, mount the antenna symmetrical with the centerline of the aircraft.

3. Avoid running current-carrying wires near the A-326A.

Caution

If it is necessary to remove the antenna elements or reinstall them after removal, use a 5/32-inch open-end wrench on both the feed-through terminal and the post attached to the antenna element. If the antenna element is tightened without using a wrench on the feed-through terminal, serious damage to the antenna may result.

2–8. INSTALLATION OF COURSE INDICATOR.

Either an ARC Type IN-10 or an ARC Type IN-14 Course Indicator is used to present the glide-slope information. Figure 2–9 shows the installation dimensions for the IN-10 and IN-14. The indicator used should be installed on a shock-absorbing panel. It may be mounted either from the front or the rear of the panel using the three No. 6-32 screws supplied.

2–9. OPERATIONAL CHECK.

An operational check of the equipment installation may be made using an ARC Type A-13B Antenna and a Boonton Radio Corp. Model 232-A Glide Slope Signal Generator. Proceed as follows:

Step 1. Choose an unobstructed area, preferably outdoors. Set up the A-13B Antenna directly ahead of the aircraft, at least 10 feet from the glide-slope antenna of the aircraft and at least 6 feet above the ground. Direct the antenna toward the aircraft.

Step 2. Connect the RF OUTPUT connector of the signal generator to the GP connector of the A-13B Antenna.

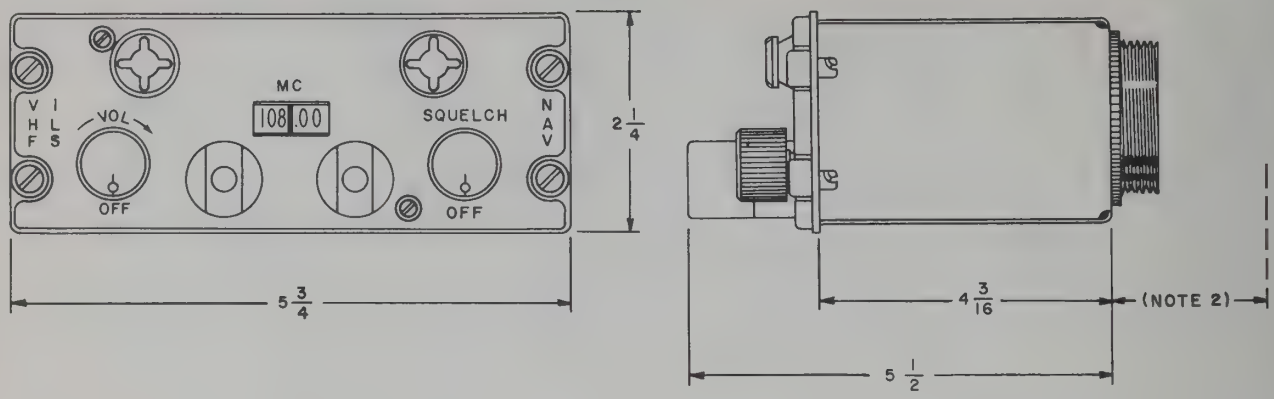
Step 3. Turn the equipment on.

Step 4. Turn the OUTPUT LEVEL control of the signal generator to the maximum-output position. (.2 volt).

Step 5. For each channel, adjust the signal generator for a standard, 700-μv on-course signal and check that the horizontal pointer of the course indicator centers for an on-course signal and that the flag disappears.

Step 6. For each channel, adjust the signal generator for a standard, 700-μv, 2-db off-course signal (90-cps modulated signal predominant) and check that the horizontal pointer deflects downward slightly more than two dots and that the flag disappears.

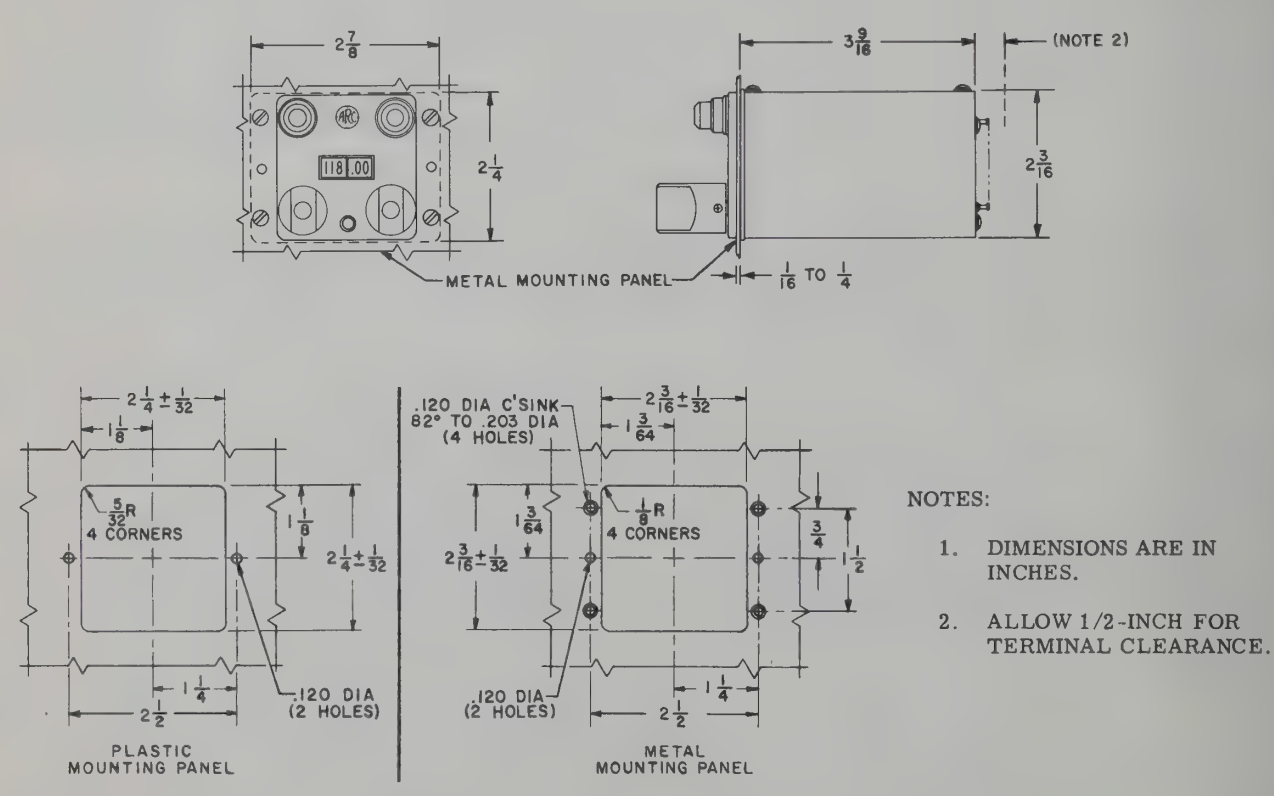
Step 7. Use the signal generator DB TONE RATIO switch and check that the flag is in full view when either the 90-cps or the 150-cps modulation signal is removed.



NOTES:
1. DIMENSIONS ARE IN INCHES.
2. ALLOW 2-1/2 INCHES FOR PLUG REMOVAL.

TP3025

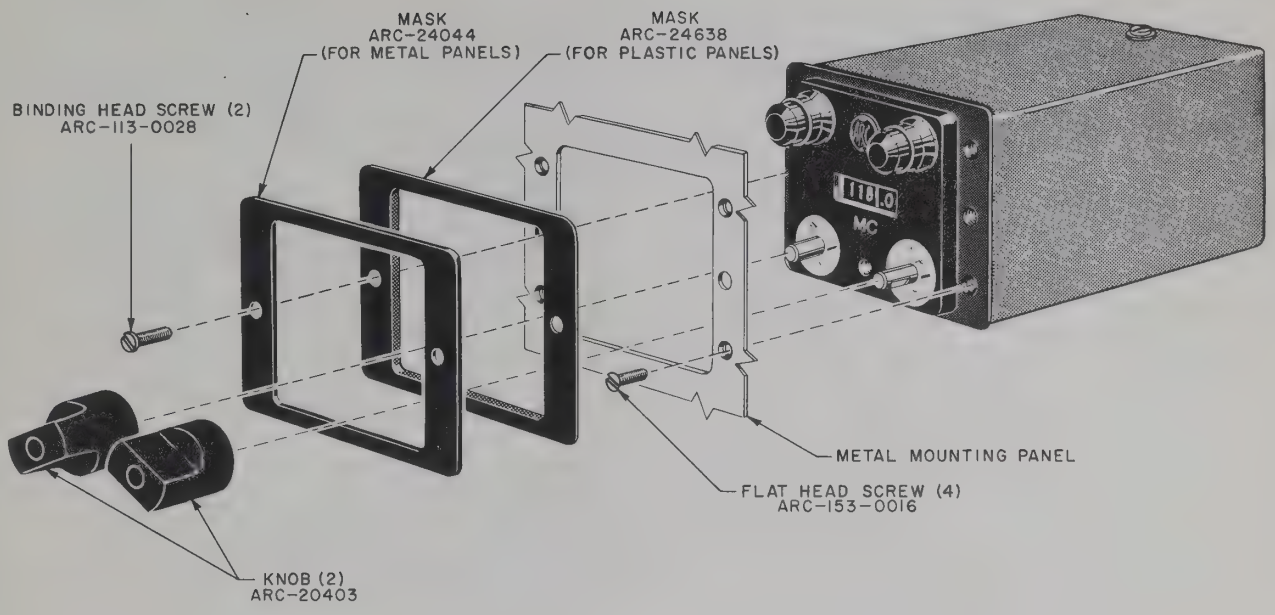
Figure 2–5. C-88A Control Unit, Installation Dimensions

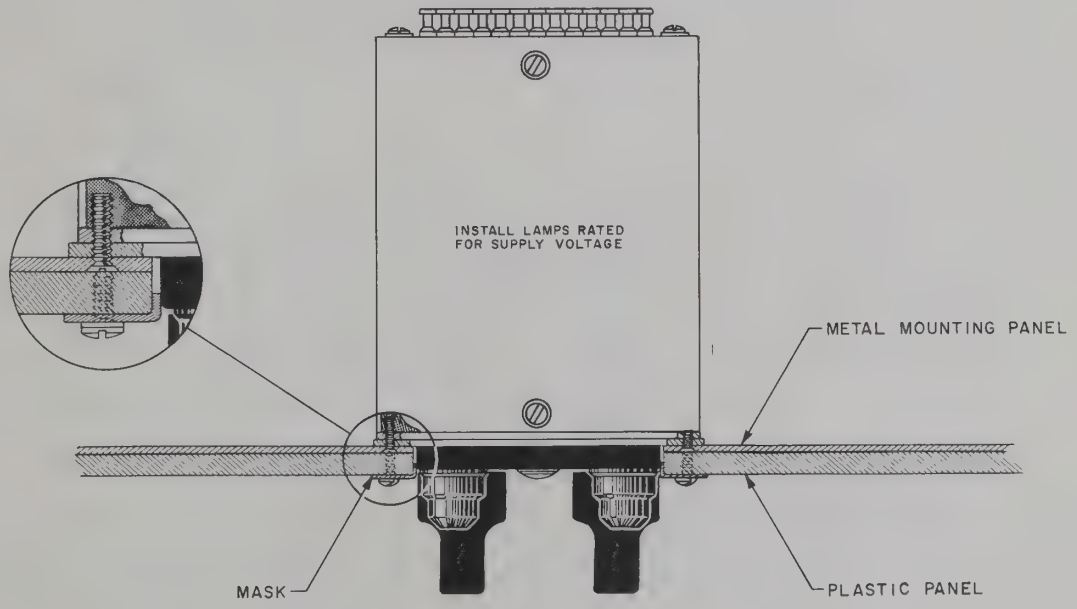


NOTES:
1. DIMENSIONS ARE IN INCHES.
2. ALLOW 1/2-INCH FOR TERMINAL CLEARANCE.

TP3027

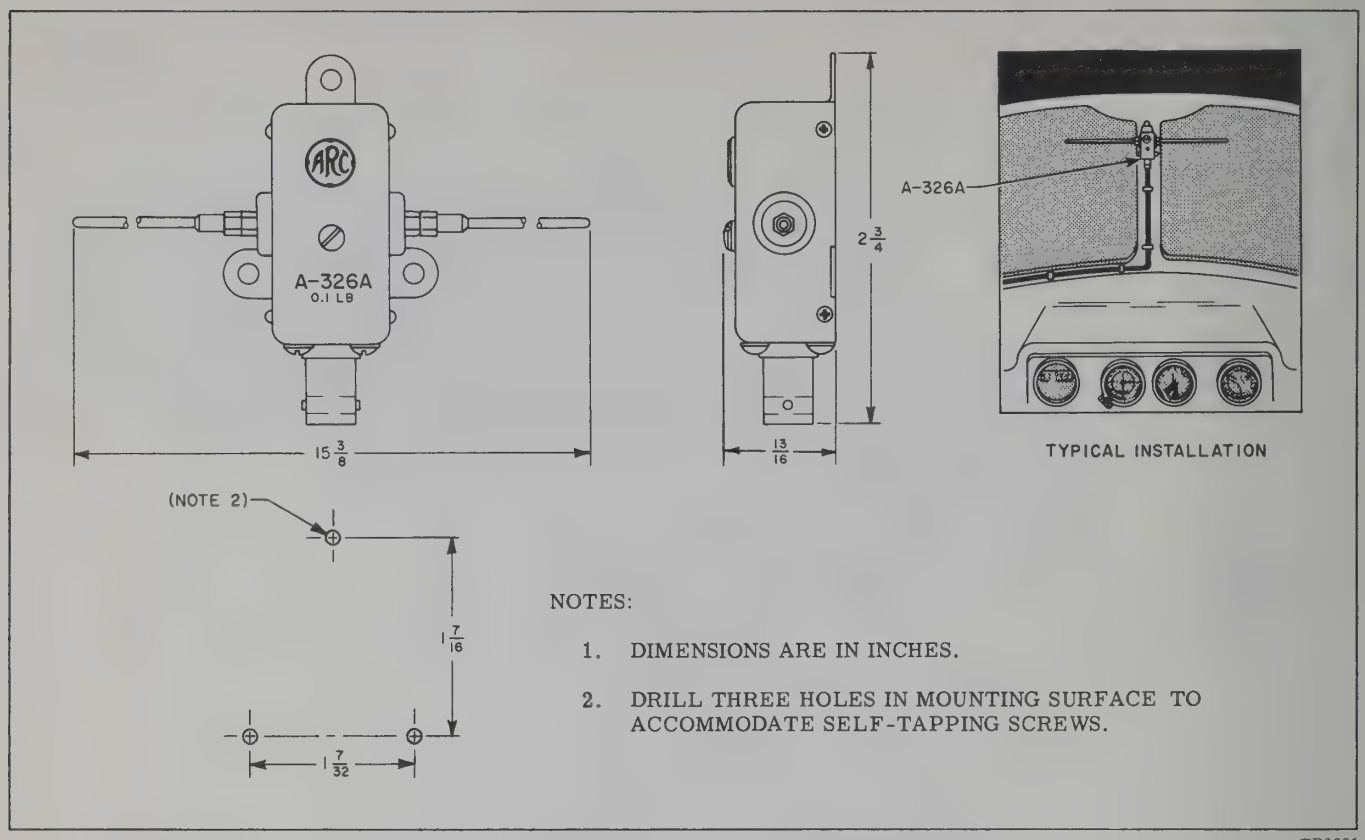
Figure 2–6. CC-12A Custom Control Unit, Installation Dimensions





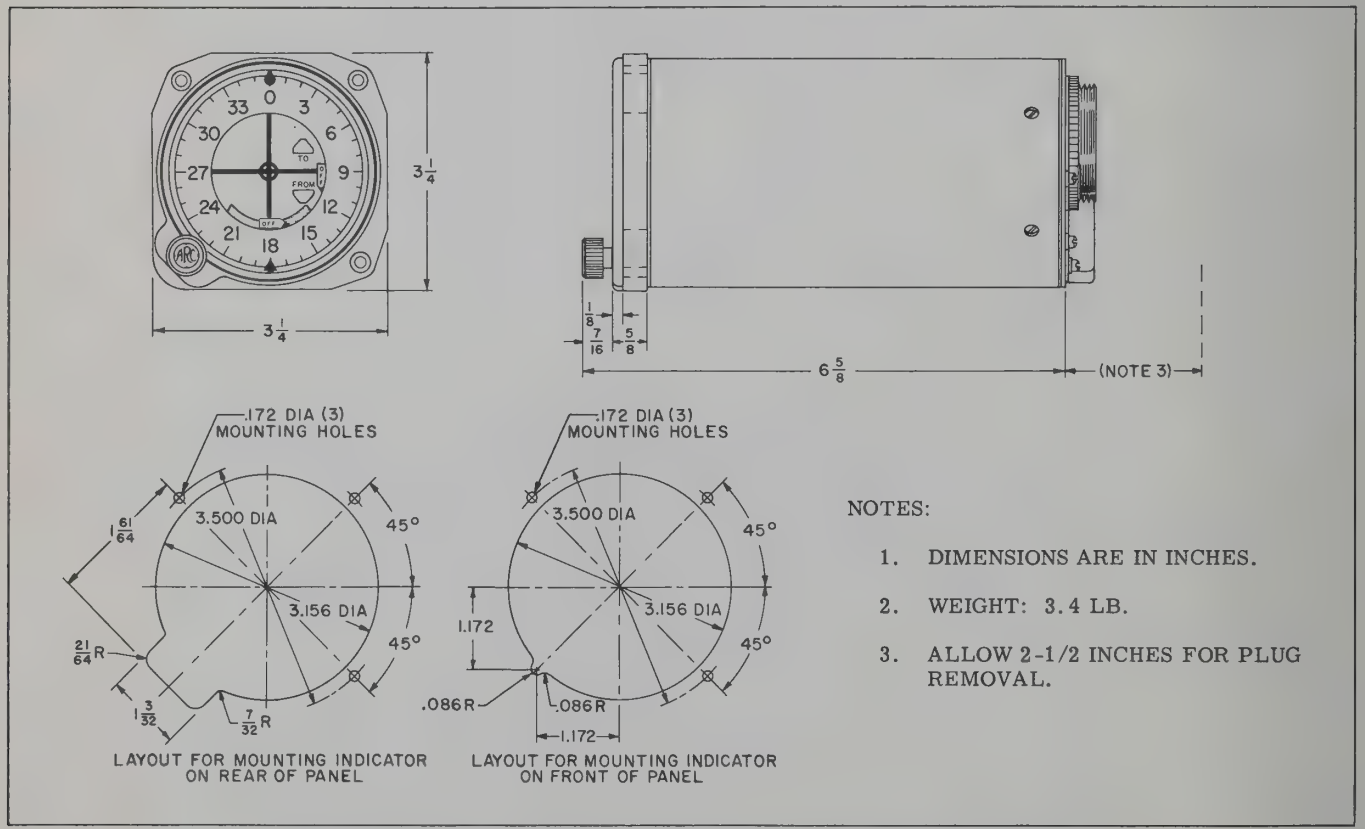
TP3029

Figure 2–7. CC-12A Custom Control Unit, Assembly Details



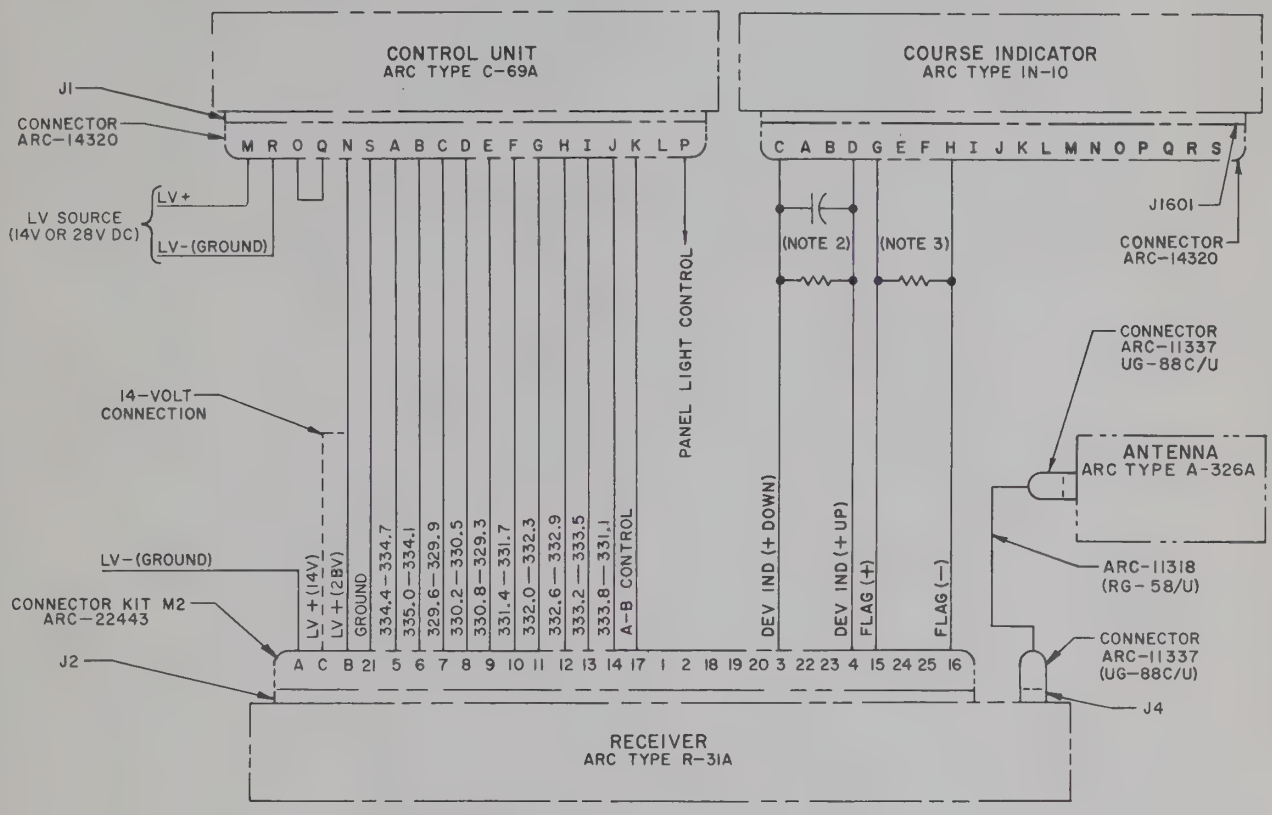
TP3031

Figure 2–8. A-326A Antenna, Installation Dimensions



TP1341A

Figure 2–9. IN-10 and IN-14 Course Indicators, Installation Dimensions



NOTES:

1. EXCEPT FOR ANTENNA LEAD, WIRES ARE NO. 20 AWG STRANDED COPPER, FIBROUS-GLASS INSULATED.
2. CONNECT A 1000-μF DAMPING CAPACITOR ACROSS THE DEVIATION-INDICATOR OUTPUT CIRCUIT OF THE R-31A RECEIVER. THIS CIRCUIT IS DESIGNED FOR THREE 1000-OHM LOADS IN PARALLEL. SHUNT WITH SUITABLE RESISTANCE IF FEWER LOADS ARE USED.
3. THE FLAG OUTPUT CIRCUIT OF THE R-31A RECEIVER IS DESIGNED FOR TWO 1000-OHM METER LOADS IN PARALLEL. SHUNT WITH A 1000-OHM RESISTOR IF ONLY ONE METER IS USED.

TP1673A

Figure 2–10. R-31A Receiver and C-69A Control Unit, Interconnection Diagram

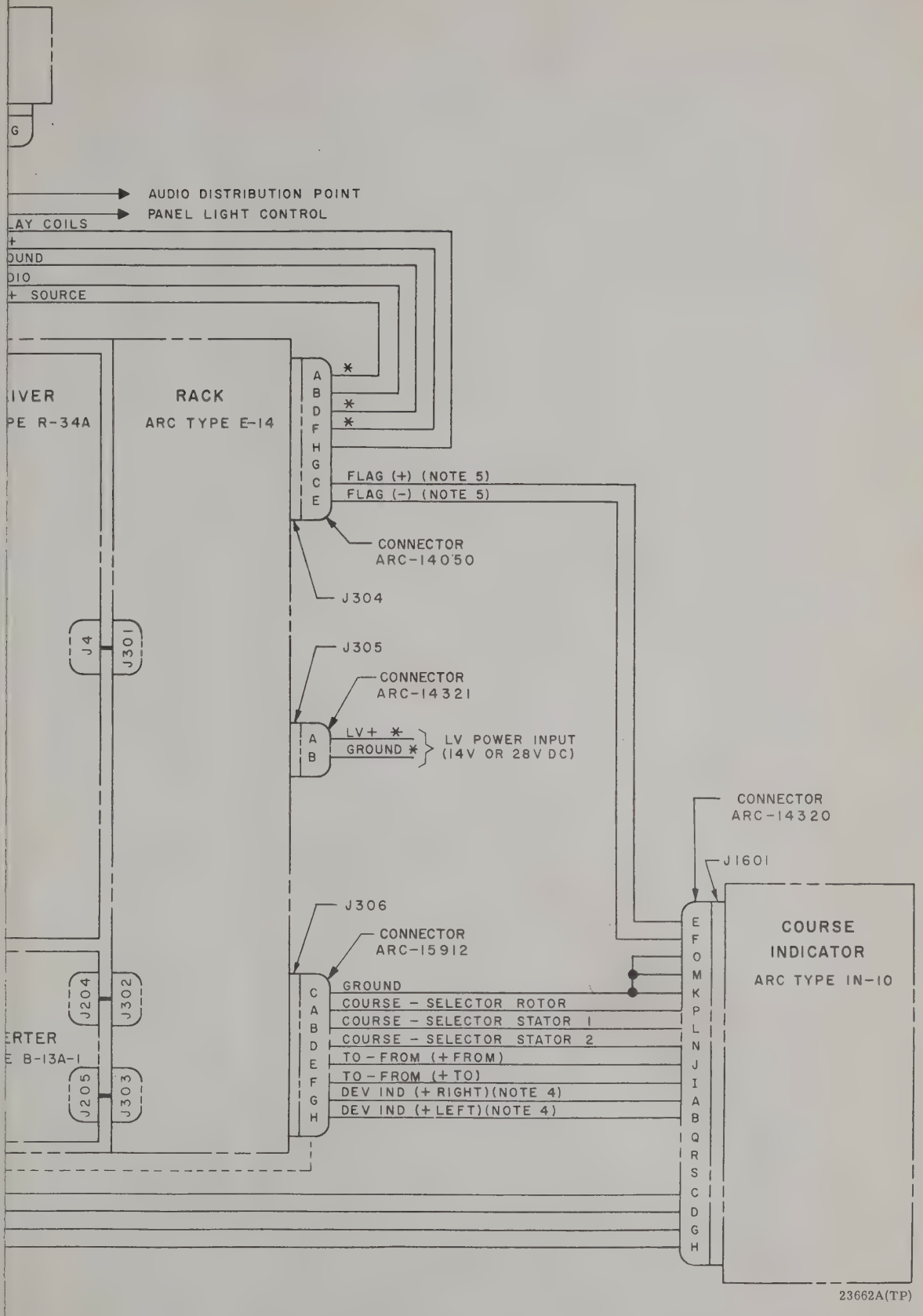


Figure 2–11. R-31A Receiver, ARC Type 15F VHF Navigation Equipment, and C-88A Control Unit, Interconnection Diagram

NOTES:

1. UNMARKED WIRES ARE NO. 20 STRANDED COPPER, FIBROUS-GLASS INSULATED. WIRES MARKED WITH AN ASTERISK (*) ARE NO. 16 STRANDED COPPER, FIBROUS-GLASS INSULATED.
2. CONNECT A 1000-μF DAMPING CAPACITOR ACROSS THE DEVIATION INDICATOR OUTPUT CIRCUIT OF THE R-31A RECEIVER. THIS CIRCUIT IS DESIGNED FOR THREE 1000-OHM LOADS IN PARALLEL. SHUNT WITH SUITABLE RESISTANCE IF FEWER LOADS ARE USED.
3. THE FLAG OUTPUT CIRCUIT OF THE R-31A RECEIVER IS DESIGNED FOR TWO 1000-OHM METER LOADS IN PARALLEL. SHUNT WITH A 1000-OHM RESISTOR IF ONLY ONE METER IS USED.
4. THE DEVIATION INDICATOR OUTPUT CIRCUIT OF THE E-14 RACK IS DESIGNED FOR ONE 1000-OHM LOAD. FOR EACH ADDITIONAL LOAD IN PARALLEL, REMOVE APPROPRIATE RESISTOR FROM THE RACK.
5. THE FLAG OUTPUT CIRCUIT OF THE E-14 RACK IS DESIGNED FOR ONE 1000-OHM LOAD. FOR EACH ADDITIONAL LOAD IN PARALLEL. REMOVE APPROPRIATE RESISTOR FROM THE RACK.

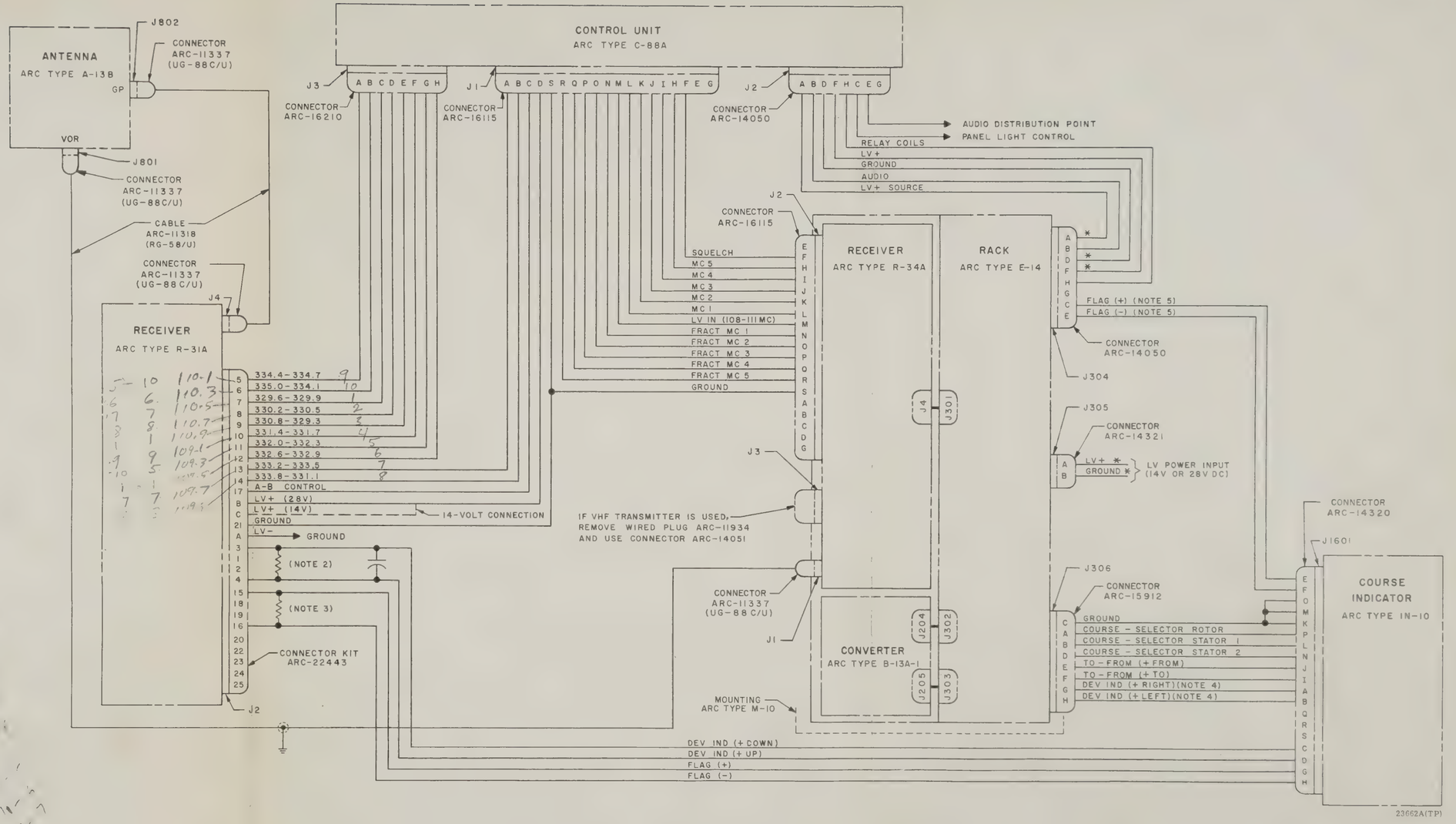


Figure 2–11. R-31A Receiver, ARC Type 15F VHF Navigation Equipment, and C-88A Control Unit, Interconnection Diagram

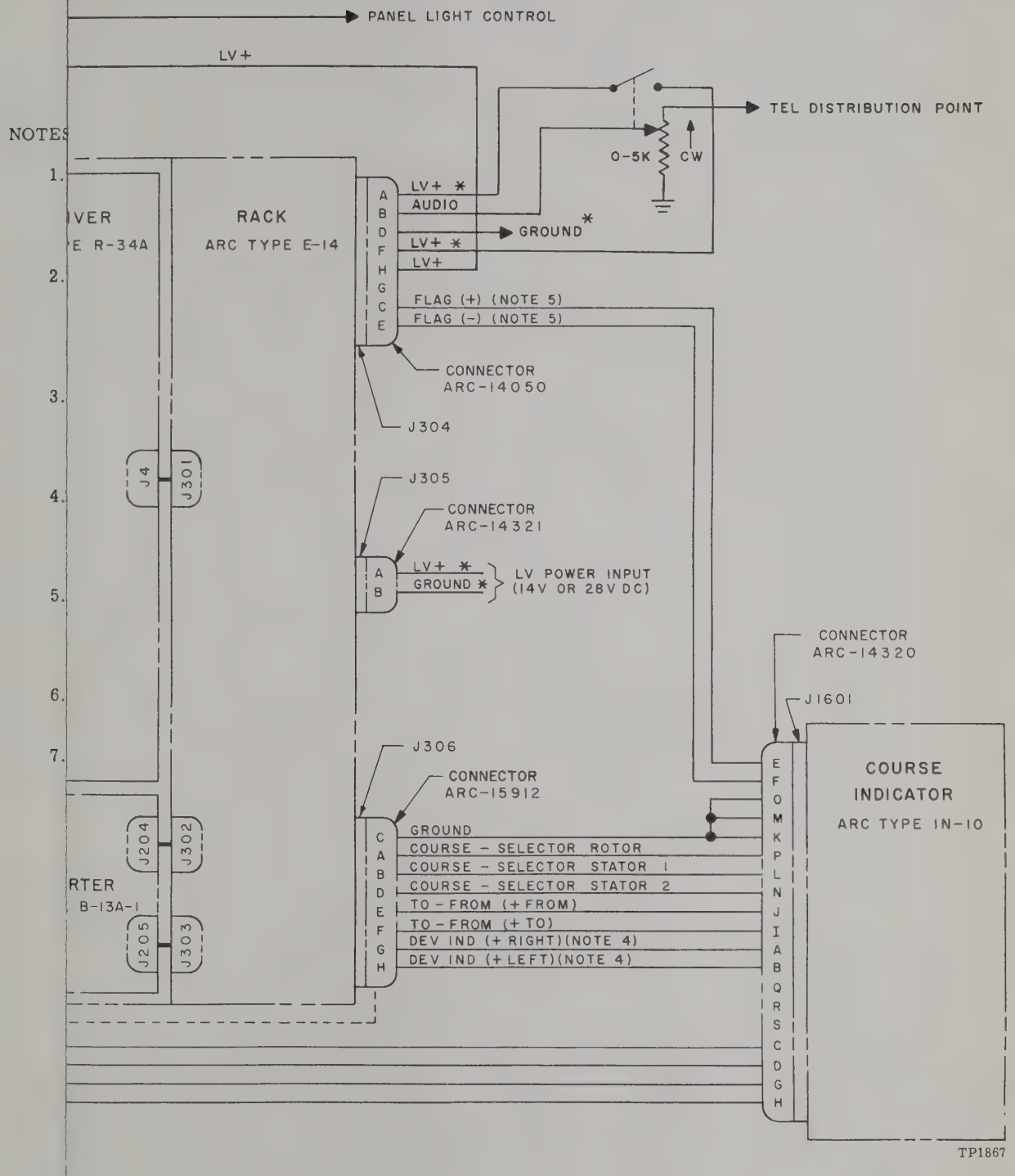


Figure 2–12. R-31A Receiver, ARC Type 15F VHF Navigation Equipment, and CC-12A Custom Control Unit, Interconnection Diagram

NOTES:

1. UNMARKED WIRES ARE NO. 20 STRANDED COPPER, FIBROUS-GLASS INSULATED. WIRES MARKED WITH AN ASTERISK (*) ARE NO. 16 STRANDED COPPER, FIBROUS-GLASS INSULATED.
2. CONNECT A 1000-μF DAMPING CAPACITOR ACROSS THE DEVIATION INDICATOR OUTPUT CIRCUIT OF THE R-31A RECEIVER. THIS CIRCUIT IS DESIGNED FOR THREE 1000-OHM LOADS IN PARALLEL. SHUNT WITH SUITABLE RESISTANCE IF FEWER LOADS ARE USED.
3. THE FLAG OUTPUT CIRCUIT OF THE R-31A RECEIVER IS DESIGNED FOR TWO 1000-OHM METER LOADS IN PARALLEL. SHUNT WITH A 1000-OHM RESISTOR IF ONLY ONE METER IS USED.
4. THE DEVIATION INDICATOR OUTPUT CIRCUIT OF THE E-14 RACK IS DESIGNED FOR ONE 1000-OHM LOAD. FOR EACH ADDITIONAL LOAD IN PARALLEL, REMOVE THE APPROPRIATE RESISTOR FROM THE RACK.
5. THE FLAG OUTPUT CIRCUIT OF THE E-14 RACK IS DESIGNED FOR ONE 1000-OHM LOAD. FOR EACH ADDITIONAL LOAD IN PARALLEL, REMOVE THE APPROPRIATE RESISTOR FROM THE RACK.
6. THE R-34A IS SHOWN CONNECTED FOR LOCAL SQUELCH ONLY.
7. RESISTANCE VALUE IS IN OHMS; MULTIPLIER K=1000.

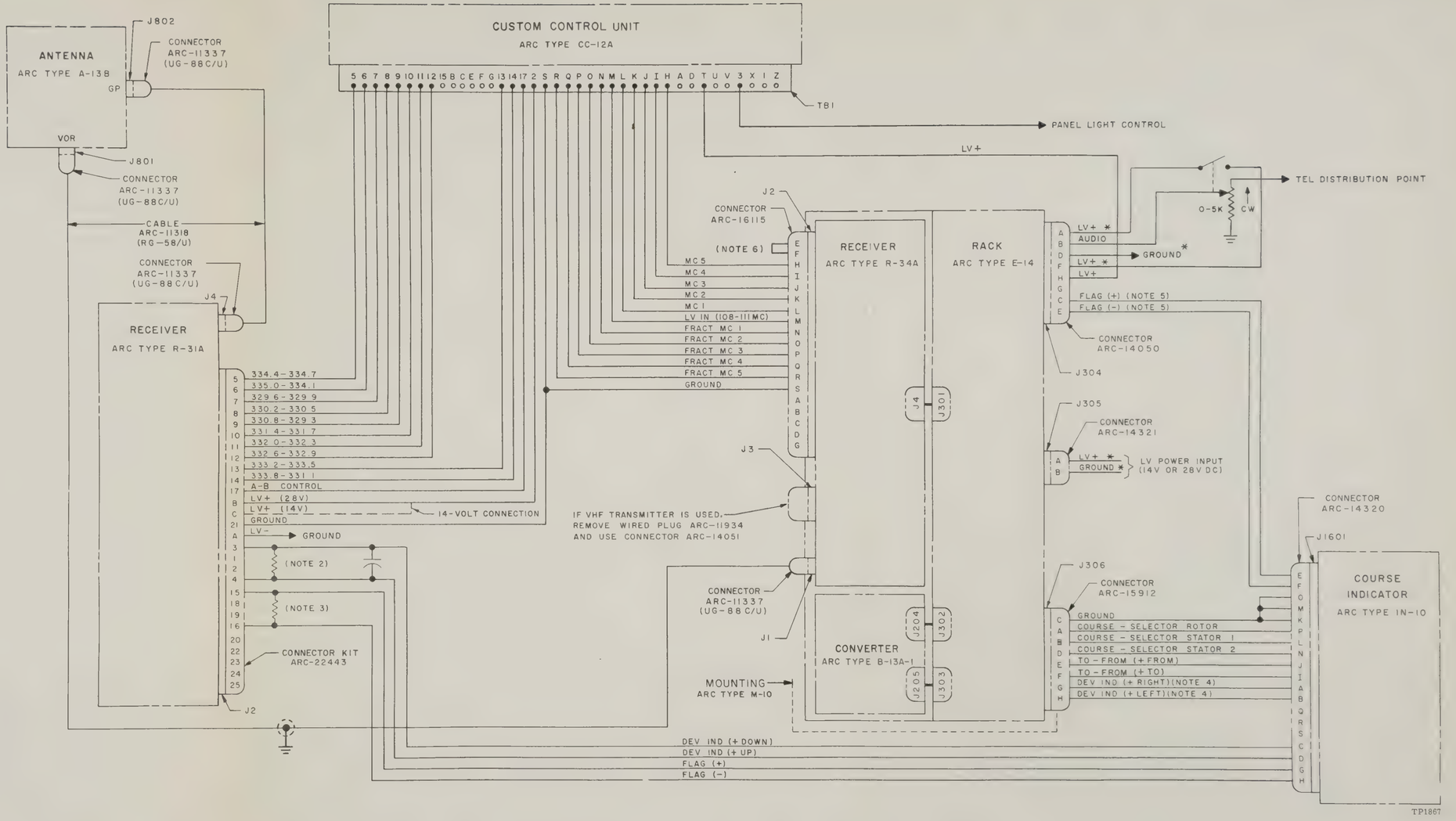


Figure 2–12. R-31A Receiver, ARC Type 15F VHF Navigation Equipment, and CC-12A Custom Control Unit, Interconnection Diagram

SECTION III

OPERATION

3–1. GENERAL.

The glide-slope transmitter transmits a radio beam at an angle of approximately 2.5° above ground. The transmitter, operating in the frequency range of 329.3 – 335.0 mc, sends out patterns that are modulated at 90 and 150 cps. The area of equal signal strength between these patterns locates the glide slope. At points above the glide slope, the 90-cps modulation is predominant; at points below the glide slope, the 150-cps modulation is predominant. The R-31A Receiver detects the 90-cps and 150-cps modulations and actuates the horizontal pointer of the deviation indicator. If the aircraft is above the glide slope, the pointer deflects downward; if the aircraft is below the glide slope, the pointer deflects upward.

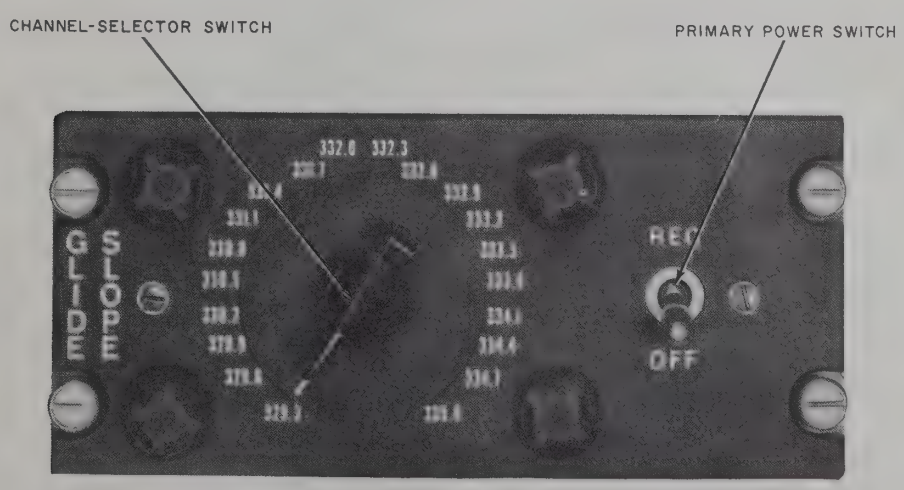
3–2. OPERATING LIMITATIONS AND PRECAUTIONS.

WARNING

EXTREME CAUTION SHOULD BE USED WHEN FLYING THE GLIDE SLOPE WHERE THE INDICATOR SHOWS THE POSITION OF THE AIRCRAFT TO BE UNDER THE GLIDE SLOPE. THE SUGGESTED LIMITS ARE NOT TO EXCEED THREE-DOT DEVIATION UP TO THE MIDDLE MARKER AND TO ALLOW NO "FLY-UP" CONDITION FROM THE MIDDLE MARKER TO COMPLETION OF LANDING.

False Glide-slope Indications. In addition to the desired glide slope, all glide-slope transmission facilities produce additional glide slopes at higher vertical angles, the lowest of these making an angle of approximately 16° with the ground. The proper use of the glide slope requires that the pilot maintain alertness as the glide-slope intersection is approached. The pilot should carefully interpret the "fly up" and "fly down" instrument indications to avoid the possibility of attempting to follow one of the higher-angle glide slopes. Provided that procedures are correctly followed and pilots are properly indoctrinated in glide-slope instrumentation, the fact that these high-angle courses exist should cause no difficulty in glide-slope navigation.

Spurious Glide-slope Indications. Glide-slope transmission facilities are intended to provide reliable glide-slope signals for use with the front course of the ILS localizer. Glide-slope signals may be received in other azimuths because of stray radiation from the transmitting antennas and reflections from nearby objects. These signals may, in some cases, be sufficient to activate the horizontal-pointer flag. Any glide-slope pointer activity in these other azimuths should be disregarded. All pilots are particularly cautioned to ignore glide-slope indications when making back-course ILS approaches. All approved procedures for back-course approaches are limited to use of the localizer portion of the ILS. Any attempt to fly spuri-



TP1342

Figure 3–1. C-69A Control Unit, Operating Controls

SECTION III

OPERATION

3–1. GENERAL.

The glide-slope transmitter transmits a radio beam at an angle of approximately 2.5° above ground. The transmitter, operating in the frequency range of 329.3 – 335.0 mc, sends out patterns that are modulated at 90 and 150 cps. The area of equal signal strength between these patterns locates the glide slope. At points above the glide slope, the 90-cps modulation is predominant; at points below the glide slope, the 150-cps modulation is predominant. The R-31A Receiver detects the 90-cps and 150-cps modulations and actuates the horizontal pointer of the deviation indicator. If the aircraft is above the glide slope, the pointer deflects downward; if the aircraft is below the glide slope, the pointer deflects upward.

3–2. OPERATING LIMITATIONS AND PRECAUTIONS.

WARNING

EXTREME CAUTION SHOULD BE USED WHEN FLYING THE GLIDE SLOPE WHERE THE INDICATOR SHOWS THE POSITION OF THE AIRCRAFT TO BE UNDER THE GLIDE SLOPE. THE SUGGESTED LIMITS ARE NOT TO EXCEED THREE-DOT DEVIATION UP TO THE MIDDLE MARKER AND TO ALLOW NO "FLY-UP" CONDITION FROM THE MIDDLE MARKER TO COMPLETION OF LANDING.

False Glide-slope Indications. In addition to the desired glide slope, all glide-slope transmission facilities produce additional glide slopes at higher vertical angles, the lowest of these making an angle of approximately 16° with the ground. The proper use of the glide slope requires that the pilot maintain alertness as the glide-slope intersection is approached. The pilot should carefully interpret the "fly up" and "fly down" instrument indications to avoid the possibility of attempting to follow one of the higher-angle glide slopes. Provided that procedures are correctly followed and pilots are properly indoctrinated in glide-slope instrumentation, the fact that these high-angle courses exist should cause no difficulty in glide-slope navigation.

Spurious Glide-slope Indications. Glide-slope transmission facilities are intended to provide reliable glide-slope signals for use with the front course of the ILS localizer. Glide-slope signals may be received in other azimuths because of stray radiation from the transmitting antennas and reflections from nearby objects. These signals may, in some cases, be sufficient to activate the horizontal-pointer flag. Any glide-slope pointer activity in these other azimuths should be disregarded. All pilots are particularly cautioned to ignore glide-slope indications when making back-course ILS approaches. All approved procedures for back-course approaches are limited to use of the localizer portion of the ILS. Any attempt to fly spuri-

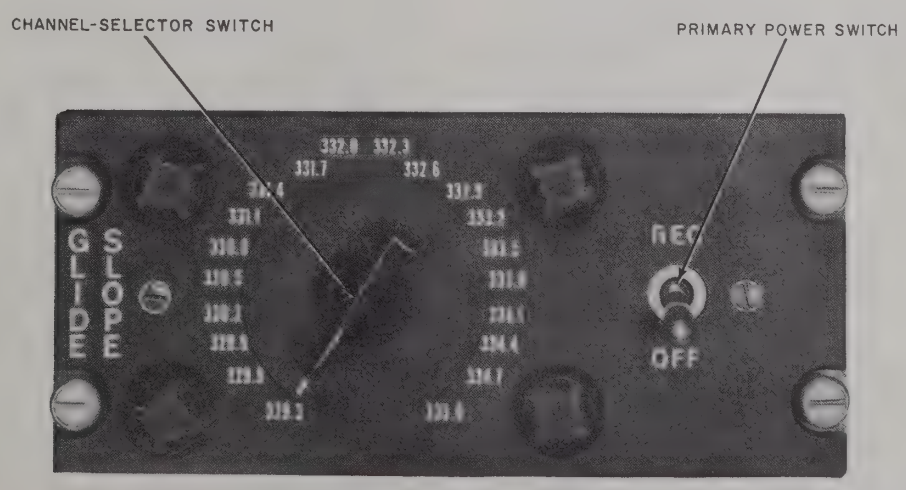


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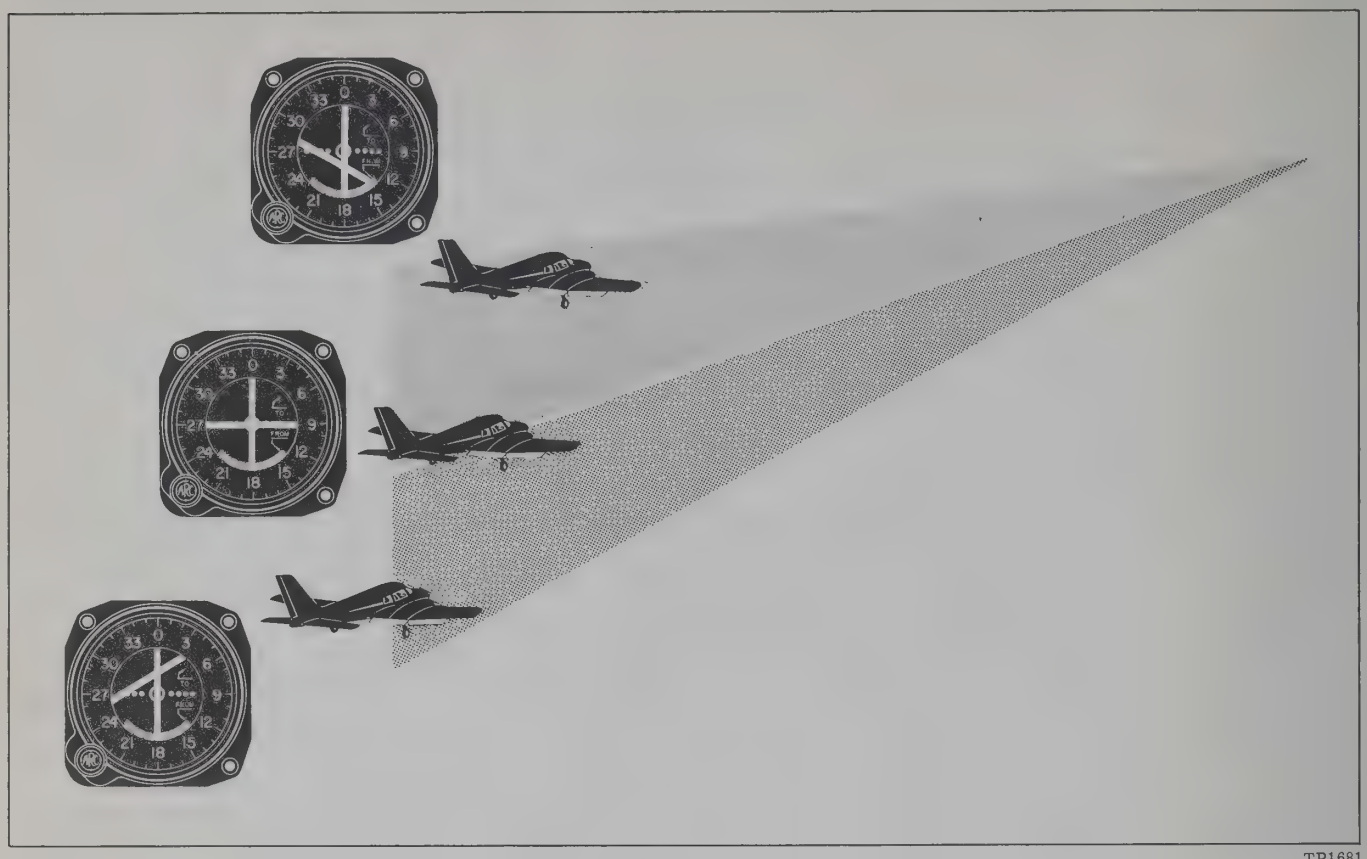
Figure 3–1. C-69A Control Unit, Operating Controls



TP1681

Figure 3–2. Typical Indicator Readings for Positions Relative to Glide Slope

ous glide-slope indications on back-course approaches could result in hazardous operations.

Unreliable Signal Indication. If the glide-slope transmitting equipment fails to send out either or both modulation patterns, or if the glide-slope receiver fails, the horizontal pointer flag will be visible, indicating an unreliable signal.

Temperature Limits. The R-31A Receiver is certified to meet the requirements of FAA TSO C-34, Category A (altitude to 50,000 feet). The unit will operate satisfactorily over a temperature range of −55° to +55°C.

3–3. OPERATING CONTROLS.

The R-31A Receiver does not include any operating controls. Operating controls are located externally and may be part of a special control unit, such as the ARC Type C-69A Control Unit. If the R-31A and an ARC Type 15F VHF Navigation Equipment are installed in the aircraft, an ARC Type C-88A Control Unit or an ARC Type CC-12A Custom Control Unit may be used to control both the R-31A and the Type 15F. When the C-88A or CC-12A is used, the R-31A is automatically tuned to the glide-slope frequency when the control unit is positioned to a localizer frequency.

The C-69A Control Unit, shown in Figure 3–1, is an integrally-lighted, plastic-panel control assembly designed for use in aircraft equipped with console mounting facilities. The C-69A contains a two-position, primary power switch and a twenty-position, rotary, channel selector switch. The primary power switch is used to control application of the low-voltage dc to the R-31A. The channel-selector switch is used to select the operating frequency of the receiver.

3–4. OPERATION.

The following procedure is based on the use of a C-69A Control Unit, shown in Figure 3–1. If a C-88A Control Unit or a CC-12A Custom Control Unit is used, the R-31A is automatically tuned when a localizer frequency is selected.

Step 1. Place the primary power switch on the C-69A to the REC position to turn on the R-31A.

Step 2. Rotate the channel selector switch to the desired glide-slope frequency.

Step 3. Observe the position of the horizontal pointer. Fly the aircraft toward the pointer to center the pointer and bring the aircraft onto the glide slope (see Figure 3–2).

SECTION IV

PRINCIPLES OF OPERATION

4–1. INTRODUCTION.

General. This section describes the principles of operation of the ARC Type R-31A Glide Slope Receiver. A functional description of the complete receiver is followed by detailed descriptions of the individual circuits. Schematic and functional diagrams are included to supplement the circuit descriptions.

Note

Unless otherwise noted, all reference designations used in the individual assembly discussions (paragraphs 4–6 through 4–11) are abbreviated. For complete identification, prefix the part designation with the assembly designation A1, A2, etc.; for example, A1C1.

Glide-slope Reception. The glide-slope transmitter, located approximately 750 feet from the approach end of the runway and approximately 400 feet from the centerline, transmits a glide-slope beam 0.8 degree wide at an angle approximately 2.5 degrees above ground level. This transmitter emits its signals in the direction of the final approach and sends practically no signals toward the far end of the runway. The glide-slope beam is composed of two sectors. One sector is modulated with a 90-cps signal and the other with a 150-cps signal. The beam is oriented so that the intersection of the two sectors creates a sloping line compatible with a normal landing rate of descent.

When the aircraft is on the glide slope, equal amounts of 90- and 150-cps modulation signals are received. When the aircraft is above or below the glide slope, one modulation signal is stronger than the other. When tuned to a glide-slope frequency, the R-31A rectifies and compares the 90- and 150-cps signals, and feeds a d-c current proportional to the difference in amplitude of these signals to the horizontal pointer circuit of the deviation indicator. If the pilot is making his approach properly, the two equal signals center the indicator reading. If the aircraft is above or below the glide slope during a front-course approach, the stronger signal will cause the indicator to read off-center by an amount determined by the displacement of the aircraft from the glide slope. For example, if the pointer deflects up, the aircraft is below the proper path and a decrease in rate of descent must be made to intercept the glide slope.

4–2. FUNCTIONAL DESCRIPTION.

As shown in Figure 4–1, a broadband r-f amplification stage, consisting of a subminiature electron tube and three tuned circuits, couples the antenna to an electron-tube mixer. The mixer combines the r-f signal with the output of an oscillator-multiplier circuit to produce a first intermediate frequency of 29.7 or 30.0 mc. The oscillator-multiplier uses one of ten crystals to provide the fundamental for the first heterodyne injection frequency. Each of the ten crystals is used for two of the twenty glide-slope channels.

The first i-f amplifier consists of four tuned circuits and a subminiature electron tube. All active circuit elements after this stage are semiconductor devices. The first i-f stage is broadbanded to cover the two frequencies of 29.7 and 30.0 mc. The output of this stage is combined with the output of a second oscillator in a transistor mixer. The second oscillator uses a transistor and one of two relay-selected crystals to produce an injection frequency of 28.3 and 31.4 mc. The resultant output of the second mixer is the second intermediate frequency of 1.7 mc.

The 1.7 mc output of the second mixer is coupled to a second i-f amplifier through a six-section filter. This filter, with a center frequency of 1.7 mc, provides most of the over-all selectivity of the receiver. The second i-f amplifier uses four transistors and has a gain of approximately 60 db.

From the second i-f amplifier, the signal goes to a detector followed by a two-stage audio amplifier. The audio signal then goes to two filters which allow only the 90- and 150-cycle audio signals to pass. The filter outputs are rectified to provide the d-c signals needed for the deviation indicator and flag circuits.

In addition to supplying the signal detector, the output of the second i-f amplifier also drives an agc detector-amplifier. With increasing signal input, the agc detector-amplifier provides a positive-going voltage that is applied to the second i-f amplifier, and a negative-going voltage that is applied to the r-f amplifier, the first mixer, and the first i-f amplifier. In this way, the agc circuit controls both the electron-tube and transistor stages.

4–3. CRYSTAL-SAVING CIRCUIT.

The crystal-saving circuit used in the R-31A uses 12 subminiature crystals for the 20 channels available. The crystals are divided into two groups. The first group contains ten crystals and provides the fundamental of the first heterodyne injection frequency. These crystals are mounted on the periphery of a rotatable turret, which is powered by a motor contained in channel selector as-

sembly A6. The second group contains the two remaining crystals and provides the second heterodyne injection frequency. One of these crystals is used for odd-megacycle channel frequencies and the other for even-megacycle channel frequencies. Crystal selection is directly controlled by a relay contained in the first i-f assembly. The relay is controlled by the channel-selector switch.

Each of the ten crystals mounted on the rotatable turret provides the first oscillator frequency for two of the 20 possible glide-slope frequencies. The glide-slope frequencies are paired so that one odd and one even frequency, separated by 300 kc, are controlled by each of the ten crystals.

One typical pair of glide-slope frequencies is 329.3 and 329.6 mc. When the channel-selector switch is set to either of these frequencies, the rotatable crystal drum will index to 49.933 mc, providing the fundamental frequency for the first crystal oscillator and doubler. The fundamental frequency is doubled (99.866 mc) by the output circuit of the first crystal oscillator doubler which is tuned to the second harmonic of the fundamental frequency. The signal is then tripled by a tripler stage to provide a first injection frequency of 299.6 mc. The 299.6-mc first injection frequency is then heterodyned with the incoming glide-slope frequency of 329.3 mc in the first mixer. The output of the first mixer contains sum and difference frequencies that are applied to the first i-f filter. The difference frequency (29.7 or 30.0 mc) is passed by the filter while all other frequencies are attenuated. In detail, if the frequency of the incoming glide-slope signal is odd (329.3 mc), the difference between it and the first injection frequency (299.6 mc) provides a first i-f signal of 29.7 mc (329.3 mc – 299.6 mc = 29.7 mc). If the frequency of the incoming glide-slope signal is even (329.6 mc) the difference between it and the first injection frequency (299.6 mc) provides a first i-f signal of 30.0 mc (329.6 mc – 299.6 mc = 30.0 mc).

The second mixer produces the final i-f signal of 1.7 mc by combining the amplified and filtered first i-f signal with the second injection frequency (output of the second crystal oscillator). Since there are two possible first intermediate frequencies (29.7 or 30.0 mc), two second injection frequencies (31.4 or 28.3 mc) are employed so that a difference frequency (second i-f) of 1.7 mc is always realized. In detail, if the incoming glide-slope frequency is odd, A2K1 will be energized, providing a 31.4-mc fundamental frequency for the second crystal oscillator. If the incoming glide-slope frequency is even, A2K1 will be deenergized, providing a 28.3-mc fundamental frequency for the second crystal oscillator. The second i-f signal (1.7 mc) is then produced in the second mixer by heterodyning the first i-f signal (29.7 or 30.0 mc) with the second injection frequency (31.4 or 28.3 mc). The difference frequency (second i-f) of 1.7 mc is passed by a six-section filter network while all other frequencies are attenuated.

A synopsis of the frequency synthesis discussed in the preceding paragraphs is shown in Table 4–1.

TABLE 4–1. TYPICAL R-31A RECEIVER FREQUENCY SYNTHESIS

	Odd Mc	Even Mc
Selected Glide-slope Frequency	329.3	329.6
First Crystal Oscillator Frequency	49.933	49.933
Doubler Output Frequency	99.866	99.866
Tripler Output Frequency (first injection frequency)	299.6	299.6
First Mixer Difference Frequency (first i-f signal)	29.7	30.0
Second Mixer Input Frequency	29.7	30.0
Second Crystal Oscillator Frequency (second injection frequency)	31.4	28.3
Second Mixer Difference Frequency (second i-f signal)	1.7	1.7

4–4. CHANNEL SELECTION.

Each of the twenty odd-tenth megacycle localizer frequencies between 108.1 and 111.9 mc is paired with a glide-slope frequency. When the R-31A Receiver is installed in an aircraft containing a Type 15F VHF Navigation Equipment, a C-88A or CC-12A Control Unit is used to operate both the R-31A and the Type 15F. When the C-88A or CC-12A is positioned to an odd-tenth megacycle localizer frequency between 108.1 and 111.9 mc, control circuits within the control unit automatically tune the R-31A to the glide-slope frequency paired with the selected localizer frequency. If the R-31A is installed in an aircraft containing VHF navigation equipment other than the Type 15F, or if a separate manual control for the R-31A is desired, a C-69A Control Unit is used. In principle, tuning of the R-31A by any of the three control units is similar.

Eleven control wires are used to connect the control unit to the R-31A. Ten of the wires are used to control the twenty possible glide-slope channels (see Figure 4–2). One odd and one even frequency are controlled by each of these wires. Each of the ten wires is connected between a switch contact in the control unit and one contact on both the "odd" and "even" sections of A8S1, a ten-position, two-section, rotary switch. The eleventh wire is used to switch between the "odd" and "even" switch sections, depending on whether an odd- or even-frequency glide-slope channel is selected.

When the pilot sets the control unit to a localizer frequency paired with a glide-slope channel, or directly to a

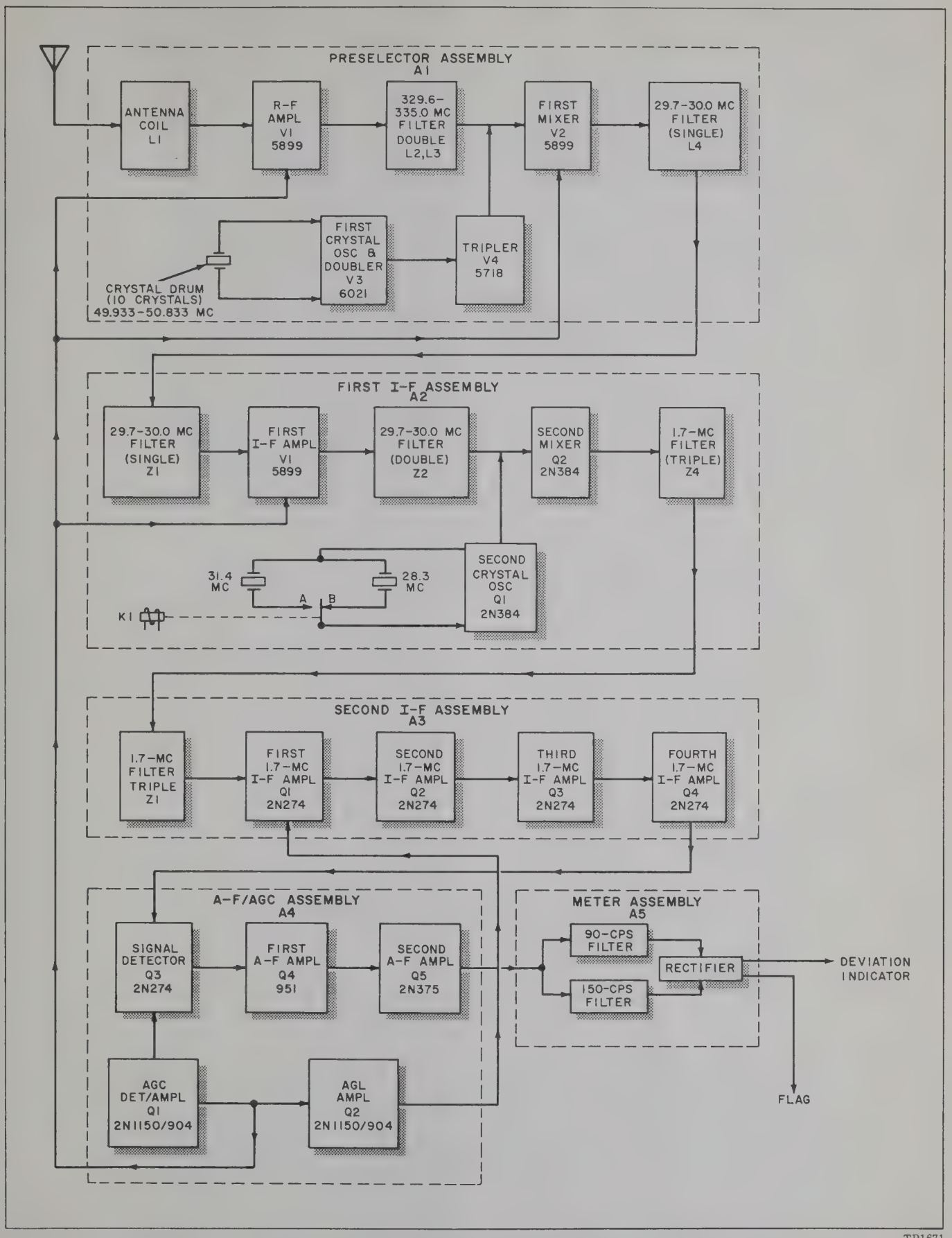


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Figure 4–1. R-31A Receiver, Block Diagram

glide-slope channel, one of the ten channel-control wires is grounded. Since each channel-control wire is connected to both the "odd" and "even" switch sections, one contact on each section is grounded.

If an even-frequency glide-slope channel is selected, ground from the control unit is connected through a contact on the "even" section of A8S1 and a normally closed set of contacts on A6K1 to the solenoid of A6K2. Since one end of the relay solenoid is connected to the supply voltage, the relay is energized. With A6K2 energized, ground is connected through a set of its normally open contacts to one pole of channel-selector B1. Since the other pole of the motor is connected directly to ground, the motor is inoperative. The output motor shaft is connected through reduction gears to a rotatable turret with ten quartz crystals mounted around its periphery. The motor also powers the movable contacts of the rotary switch. In the static condition, the rotatable turret is positioned so that the pins of one crystal engage a set of spring contacts protruding from the underside of the preselector assembly. This crystal provides the first crystal oscillator frequency for the selected glide-slope channel. In addition, the movable contact on the "even" section of the rotary switch is positioned at the grounded terminal and A2Y1, which provides the second crystal oscillator frequency when an even frequency glide-slope channel is selected, is switched into the circuit by A2K1.

If an odd-frequency glide-slope channel is selected, ground from the control unit is connected to the solenoid of A6K1. Since the other end of the relay solenoid is connected to the supply voltage, A6K1 is energized. Ground is connected through a normally open set of contacts on A6K1 to the solenoid of A6K2. Since the other end of this relay solenoid is connected to 9.5 volts dc, the relay is energized. A2Y2, which provides the second crystal oscillator frequency when an odd frequency glide-slope channel is selected, is switched into the circuit through a set of normally open contacts on A2K1. With A6K1 energized, ground from the control unit is connected through a contact on the "odd" section of S1 and a normally open set of contacts on A6K1 to the solenoid of A6K2. Since one end of the relay solenoid is connected to the supply voltage, the relay is energized. With A6K2 energized, ground is connected through a set of its normally open contacts to one pole of channel selector motor A6B1. Since the other pole of the motor is connected directly to ground, the motor is inoperative.

The static condition is upset when the channel-selector switch on the control unit is positioned at a new frequency, thus removing the ground from the previously grounded terminals of the rotary switch. When this ground is removed, A6K2 will deenergize and the supply voltage will be connected through a set of its normally closed contacts to one pole of the channel selector motor.

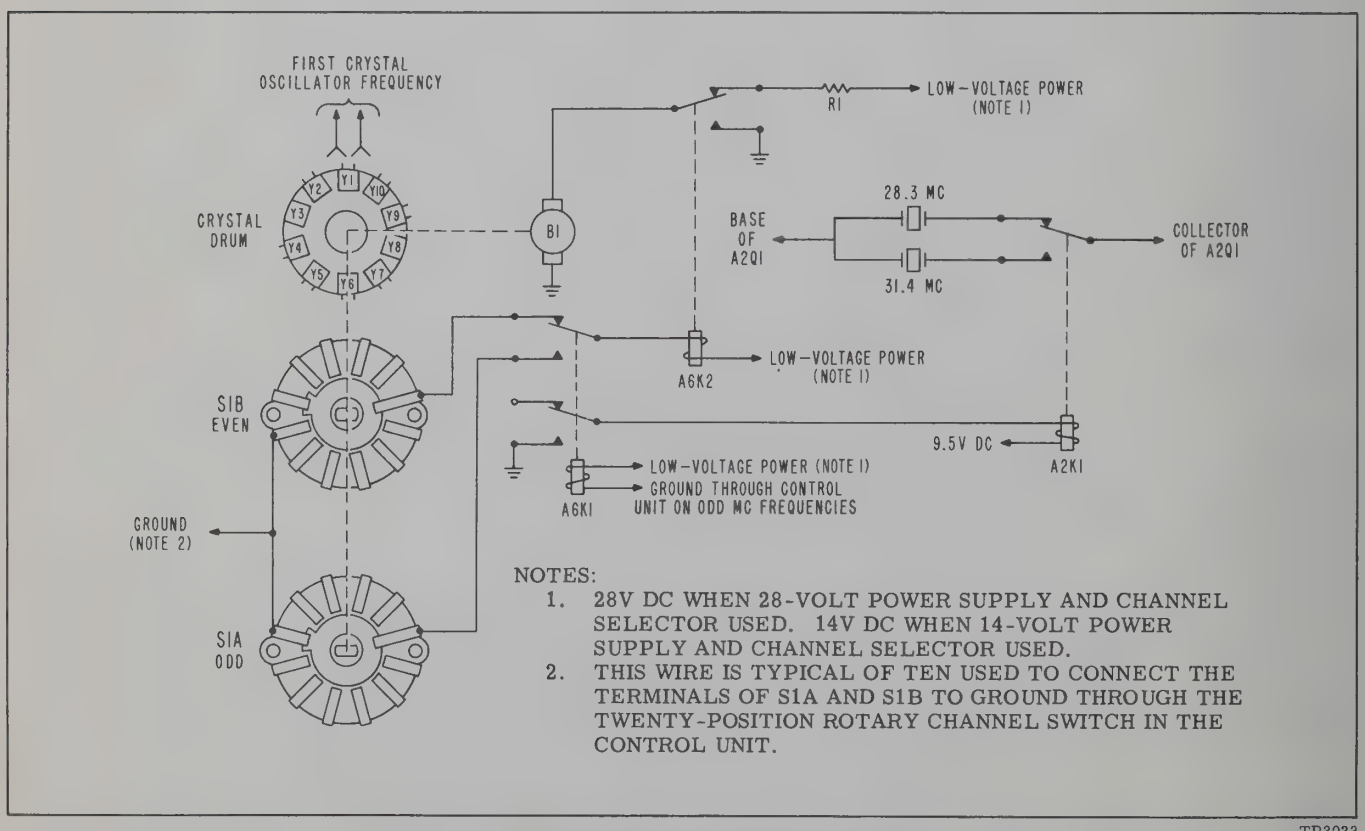

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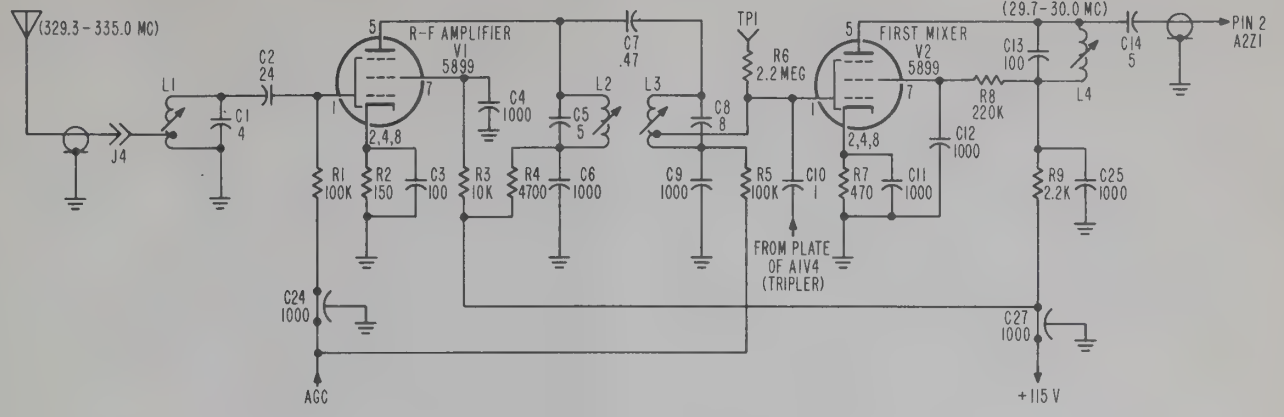
Figure 4–2. Channel Selection Functional Diagram



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A1; FOR EXAMPLE, A1L1.
2. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F).
3. RESISTOR VALUES ARE IN OHMS. MULTIPLIERS: K=1000, MEG=1,000,000.

TP3035

Figure 4–3. R-f Amplifier and First Mixer, Schematic Diagram

The motor will operate and turn the rotatable crystal turret and the movable contacts of the rotary switch until one of the movable contacts is positioned opposite the grounded terminal. When the grounded terminal is contacted, A6K2 is energized, removing the operating voltage and disconnecting the channel selector switch.

4–5. TEMPERATURE STABILITY.

The electron tube and transistor circuits contained in the R-31A are temperature-stabilized to provide reliable operation over a wide range of temperatures. Temperature stabilization is accomplished by using temperature-sensitive resistors, silicon transistors, tantalum capacitors, and degenerative-feedback circuits.

Temperature-sensitive resistors, which have a positive temperature coefficient, are used in the emitter circuit of the second 1.7 mc i-f amplifier A3Q2, agc detector-amplifier A4Q1, and agc amplifier A4Q2 (See Figure 6–1). By using temperature-sensitive resistors, the collector reverse current (I_{CBO}) and the emitter-base potential (V_{BE}) of these stages are held constant with large variations in temperature. With an increase in temperature, the temperature-sensitive resistors will increase in resistance. This increase in resistance reduces the forward bias and thereby helps maintain a constant emitter current. Without temperature stabilization, the collector reverse current will increase with the temperature, causing a corresponding increase first in the collector current and then in the junction temperature. Higher junction temperature will raise the collector reverse current. The resultant "thermal runaway" will damage the transistor.

Silicon transistors are employed in agc detector-amplifier A4Q1, agc amplifier A4Q2, and first audio amplifier A4Q4. Since the collector reverse current of a silicon transistor is small compared to that encountered in a germanium transistor, the combination of d-c coupled silicon and germanium transistors used in the R-31A provides high stabilization. For example, with an increase in temperature, the collector reverse current of A4Q5 will increase. The portion of the saturation current flowing through A4R14 will cause an additional voltage drop and thereby reduce the conduction of A4Q4. At the same time, the forward bias of A4Q5 is reduced, stabilizing the operating point.

Tantalum capacitors, because of their negative temperature coefficient, are used for low-frequency bypassing in first i-f assembly A2, second i-f assembly A3, a-f agc assembly A4, and high-voltage power supply A7.

Degenerative feedback is employed throughout the R-31A to further improve stability. For example, A4R13 and A4R16 (the emitter resistors of A4Q4 and A4Q5, respectively) provide degeneration to improve the stability of the individual audio amplifiers. Also, degenera-

tive feedback from the output of A5T1 is coupled to the base of A4Q4 by A4R15, which stabilizes the over-all gain and minimizes distortion from the audio stages.

4–6. PRESELECTOR ASSEMBLY.

The preselector assembly, A1, comprises the following stages: an r-f amplifier, the first mixer, a crystal oscillator-doubler, and a frequency tripler.

R-f Amplifier. As shown in Figure 4–3, the signal from the glide-slope antenna is conducted through the RG-58/U coaxial cable, which has a nominal impedance of 52 ohms, to the antenna jack, J4. From J4 the signal is connected to a tuned tank circuit consisting of C1 and L1. The tank circuit has a wide bandpass (low Q) and is tuned to accept frequencies within the range of 329.3 – 335.0 mc with a center frequency of 332.0 mc. From the tank circuit the signal is coupled through C2 to the grid of r-f amplifier V1. V1 is a 5899 r-f pentode, connected as a class A r-f amplifier. The output of V1 is coupled through a 329.3 – 335.0 mc double-tuned transformer consisting of L2 and L3 and C5, C6, C7, C8, and C9. The output of the transformer, taken from a low-impedance tap on L3, is coupled to the grid of first mixer V2. Agc voltage is applied to the grid circuit of the r-f amplifier through R1.

First Crystal Oscillator-Doubler and Tripler. The first crystal oscillator-doubler uses a 6021 twin-triode, V3, in a modified Butler oscillator-doubler circuit. The output of the doubler is coupled to a 5718 triode tripler, V4 (see Figure 4–4). The purpose of this stage is to generate the injection frequency for first mixer V2. Depending upon the setting of the channel-selector switch on the associated control unit, one of ten subminiature crystals mounted on the rotatable crystal drum is connected between the cathodes of V3. The first triode, V3A, is connected as a grounded-grid amplifier; the second triode, V3B, is connected as a split-load cathode follower and frequency doubler.

The modified Butler oscillator circuit operates as follows: C15 and L5 form the plate tank circuit for V3A. The tank circuit has a wide bandpass (low Q) and is tuned to accept frequencies within the range of 49.933 – 50.833 mc. R-f voltage appearing at the plate of V3A is coupled to the grid of V3B through C17. The oscillator crystal, Y1–Y10, oscillating in the series resonant mode, acts as a low-value resistance at its resonant frequency and transmits the voltage appearing at the cathode of V3B to the cathode of V3A. In turn, V3A, connected as a grounded-grid amplifier, reinforces the signal at its plate. Thus, the positive feedback necessary to sustain oscillation is obtained, but only at the frequency at which the crystal is resonant.

Frequency doubling is accomplished by tuning the plate circuit of V3B to the second harmonic (99.866 – 101.666 mc) of the oscillator. C18 and L7 make up the doubler tank circuit. The output of the doubler circuit is coupled through C20 to the grid of the 5718 triode tripler, V4. The plate circuit of V4 is tuned to the third harmonic (299.60 – 305.00 mc) of the doubler or the sixth harmonic of the fundamental crystal frequency. The tripler tank circuit consists of C23 and L8. The output of the tripler is coupled to the grid of first mixer V2.

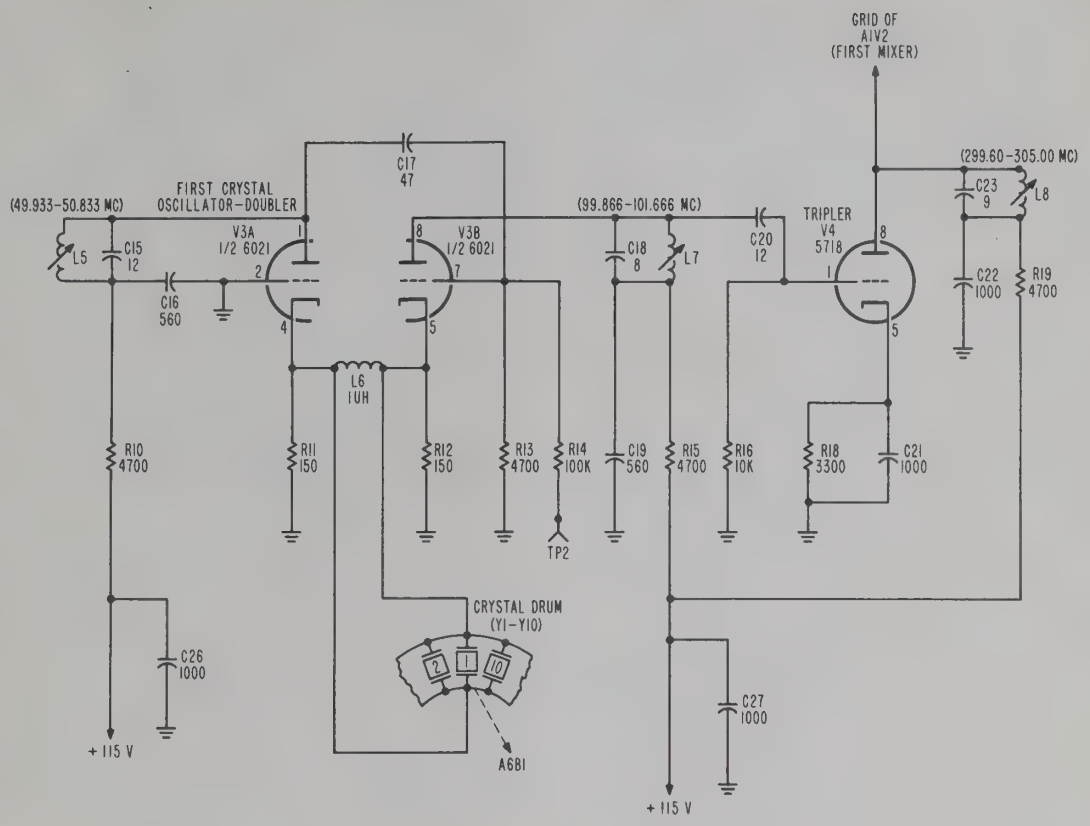
First Mixer. The first mixer employs a 5899 pentode, V2 (see Figure 4–3). The r-f signal output (329.3 – 335.0 mc) of the interstage double-tuned transformer is coupled to the grid of V2 from the low-impedance tap on L3. The injection frequency (299.60 – 305.00 mc) provided by tripler V4 is coupled to the grid of the first mixer by C10. The injection frequency beats in the mixer with the received signal frequency to produce a first i-f signal of 29.7 or 30.0 mc. If the received signal is odd, the first i-f signal will be 29.7 mc. If the received signal is even, the first i-f signal will be 30.0 mc. The output of V2 is coupled to the grid of the first i-f amplifier, A2V1 by a synchronously tuned circuit comprising L4, C13, A2Z1, and the capacity of the interconnecting coaxial cable. Agc voltage is applied to the grid of V2 through isolation resistor R5.

4–7. FIRST I-F ASSEMBLY.

The first i-f assembly, A2, employs the following stages: an i-f amplifier, second mixer, second crystal oscillator, and three sections of the six-section i-f filter network.

First I-f Amplifier. As shown in Figure 4–5, the 29.7- or 30.0-mc first intermediate frequency is coupled from first mixer A1V2 to pin 2 of the 29.7 – 30.0-mc bandpass filter, Z1. The output of Z1 is connected to the grid of first i-f amplifier V1. V1, a 5899 r-f pentode, is connected as a class A r-f amplifier. The output of V1 is coupled to double-tuned bandpass filter Z2. Z2, slightly overcoupled, provides a bandpass of 29.7 – 30.0 mc to permit passage of either of the two possible first intermediate frequencies. The filtered 29.7- or 30.0-mc first intermediate frequency signal is coupled to the emitter of second mixer Q2 through a low-impedance tap on the tuned secondary winding of Z2. Capacitor C4 is used to bypass the secondary winding of Z2. Agc voltage is applied to the amplifier circuit through pin 4 of Z1.

Second Crystal Oscillator. The second crystal oscillator uses a 2N384 p-n-p germanium transistor, Q1, in a modified Pierce oscillator circuit (see Figure 4–6). This circuit generates the injection-frequency signal for second mixer Q1. Depending on the frequency of the incoming glide-slope signal, either of two hermetically-sealed, quartz crystals (Y1 or Y2) may be switched into the base-to-collector circuit of Q1 by K1. When an even-tenth-megacycle glide-slope frequency is selected, K1 is



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A1; FOR EXAMPLE, A1L5.
2. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F).
3. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.
4. SECTIONS OF DUAL TRIODE ARE IDENTIFIED BY A AND B FOR REFERENCE PURPOSES.

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Figure 4–4. First Crystal Oscillator-Doubler and Tripler, Schematic Diagram

deenergized and Y1, with a resonant frequency of 28.3 mc, is connected into the base-to-collector circuit. Simultaneously, C7 is shunted across the input terminals of Z3, thus tuning the primary of the transformer to the lower of the two frequencies. Z3 employs a tuned primary and an untuned secondary. When an odd-tenth-megacycle glide-slope frequency is selected, K1 is energized and Y2, with a resonant frequency of 31.4 mc, is connected into the base-to-collector circuit. Capacitor C7 is switched out of the circuit and the transformer is correspondingly tuned to the higher frequency. Since the operating frequency of a transistorized Pierce oscillator is determined by the resonant frequency of the crystal connected between its base and collector, the second crystal oscillator may operate at either 28.3 or 31.4 mc.

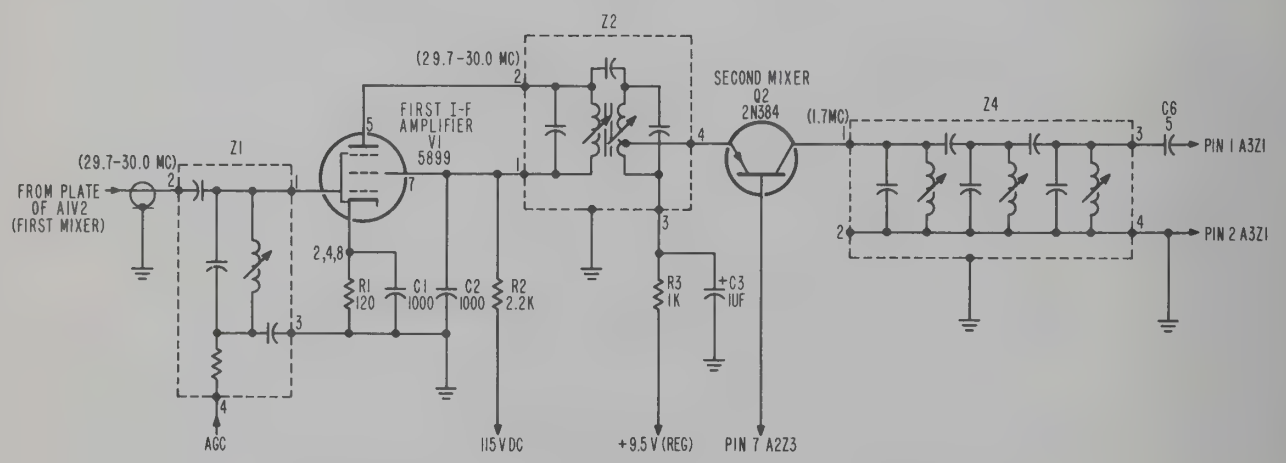
The output of Q1 is coupled to tuned transformer Z3, which is tuned on the inductive side of resonance for stable oscillator operation. The inductive output of Z3 is coupled to the base of second mixer Q2 to provide injection voltage. The base-bias network consisting of R4 and R6 provides common-point biasing for Q1 and Q2. Additional d-c stabilization is obtained by the emitter resistors, R7 for Q1 and R3 for Q2.

Second Mixer. The second mixer uses a 2N384 p-n-p germanium transistor, Q2, in the common-base connection (see Figure 4–5). The 29.7- or 30.0-mc first intermediate frequency is connected from pin 4 of the double-tuned filter, Z2, to the emitter of Q2. The 28.3- or 31.4-mc second injection frequency is connected from pin 7 of filter Z3 to the base of Q2. Bypassing at the first and second intermediate frequencies of the emitter and base circuit is provided by C4 and C3 respectively. The radio frequency injected into the emitter circuit and the oscillator frequency injected into the base circuit are heterodyned in Q2. The second intermediate frequency of 1.7 mc is selected by a six-section cascade filter having a center frequency of 1.7 mc. The filter attenuates spurious mixer signals and passes the 1.7-mc second intermediate frequency with less than 3-db reduction in signal strength. Physically, the filter consists of two three-section portions coupled by C6. The second section of the filter is contained in second i-f assembly A3.

4–8. SECOND I-F ASSEMBLY.

The second i-f assembly, A3, consists of the second three sections of the six-section, 1.7-mc, i-f filter network and a four-stage, 1.7-mc, i-f amplifier.

As shown in Figure 4–7, the output of the six-section, 1.7-mc, i-f filter network is coupled through a four-transistor, broadly resonant, 1.7-mc, i-f amplifier before it is connected to the signal detector. The amplifier uses four 2N274 p-n-p germanium transistors, Q1, Q2, Q3, and Q4, and provides an over-all gain of approximately 60 db. Q1 is common-collector or emitter-follower con-

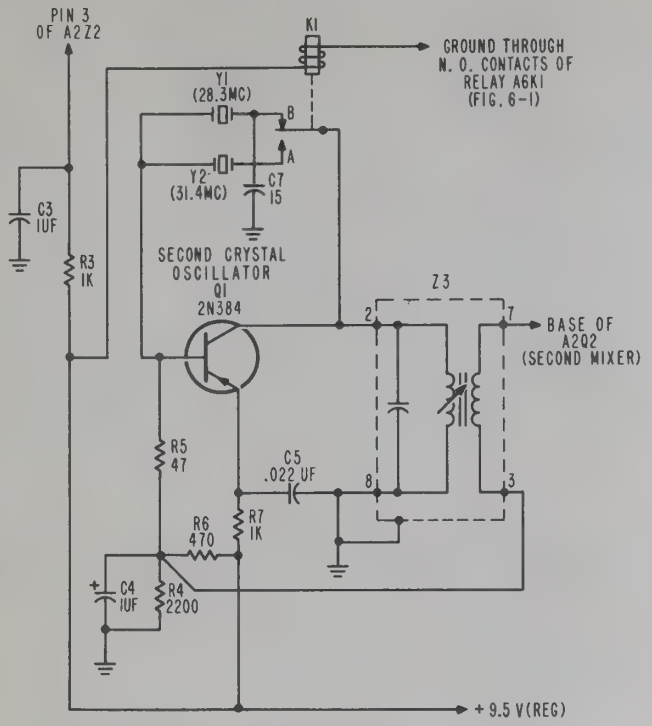


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A2; FOR EXAMPLE, A2Z1.
2. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F), UNLESS OTHERWISE NOTED.
3. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.

TP3039

Figure 4–5. First I-f Amplifier and Second Mixer, Schematic Diagram



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A2; FOR EXAMPLE, A2K1.
2. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F), UNLESS OTHERWISE NOTED.
3. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.

TP3041

Figure 4–6. Second Crystal Oscillator, Schematic Diagram

nected. Q2 and Q3 are common-emitter connected for gain and Q4 is common-base connected for gain and stability.

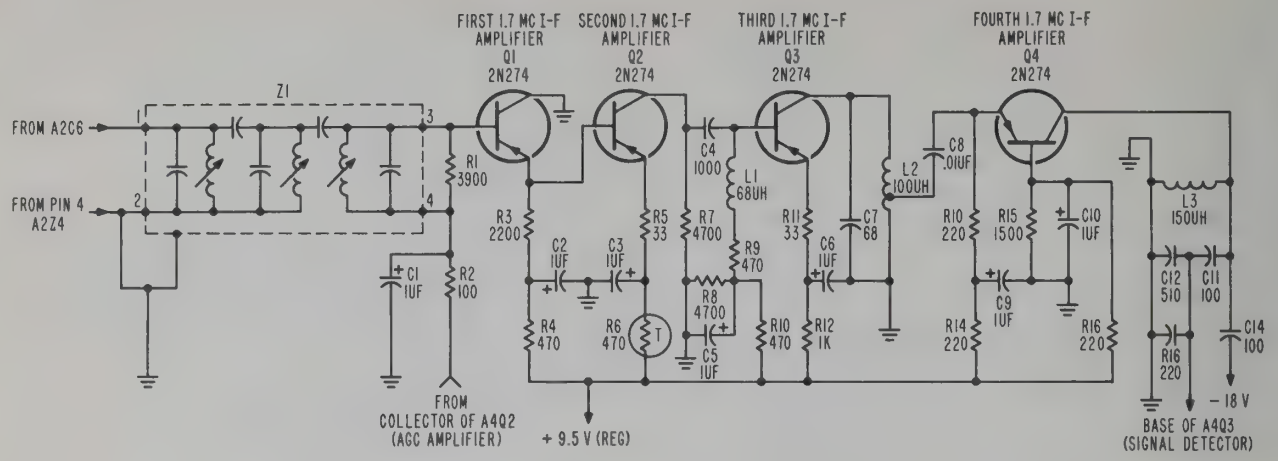
The 1.7-mc i-f output of Z1 is connected to the base of the first 1.7-mc amplifier, Q1. Q1 is connected as an emitter-follower to allow low capacitive and resistive loading of the six-section filter. R1 provides the desired end-loading for the filter. The input impedance of Q1 is high to provide negligible loading. The emitter-follower or grounded-collector amplifier is similar to the electron tube cathode-follower circuit. The only difference between the two is that in the emitter-follower circuit, the output impedance of the transistor circuit is dependent on the input impedance. Q1 and Q2 form a d-c coupled amplifier with positive-going agc voltage connected through a-c decoupling resistor R1 to the base of Q1. R6 is a positive temperature-coefficient resistor used to provide d-c operating point stability for Q2 under various temperature extremes. L1 and C4, and L2 and C7 each form broadly resonant circuits at the i-f frequency of 1.7 mc. Since each is a low-Q resonant circuit, they do not contribute appreciably to the over-all selectivity which is developed primarily by the six-section filter. The tuned circuit formed by L2 and C7 is tapped down to establish a low impedance matching point to the emitter of Q4. Q4 is in the common-base configuration to insure stable amplification from this high-level i-f stage.

4–9. AF-AGC ASSEMBLY.

The af-agc assembly, A4, comprises the following stages: an agc detector-amplifier, an agc amplifier, a signal detector, and two stages of audio amplification.

Agc Circuits. The agc portion of assembly A4 consists of the agc detector-amplifier and the agc amplifier. Both of these stages use a 2N1150 n-p-n silicon transistor as the active circuit element. The agc circuit is used to automatically vary the gain of the R-31A in accordance with the strength of the glide-slope signals received at the antenna. The agc circuit provides an output regulation with less than 3 db variation, with an input signal change from 10 to 10,000 μv. To accomplish this regulation, a negative-going agc voltage is applied to the grid of r-f amplifier A1V1, the grid of first mixer A1V2, and the grid of first i-f amplifier A2V1. In addition, a positive-going agc voltage is applied to the base of first 1.7-mc i-f amplifier A3Q1.

As shown in Figure 4–8, the base of Q1 is connected through L1 to the –18 volt dc potential. The emitter of Q1 is connected to the same potential through the parallel combination of R18 and temperature-sensitive resistor R17. Since the negative potential on the base is greater than the negative potential on the emitter, Q1 is reverse-biased to cutoff. This resistive divider bias and the transistor base-to-emitter contact potential provide a delay

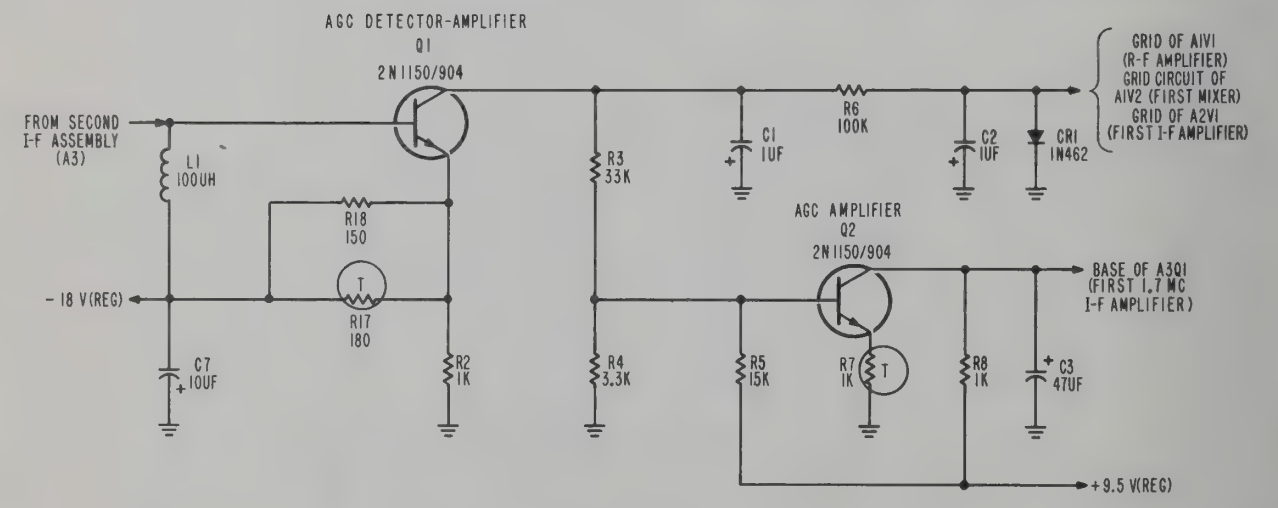


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A3; FOR EXAMPLE, A3Z1.
2. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F), UNLESS OTHERWISE NOTED.
3. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.

TP3043

Figure 4–7. Second I-f Filter and 1.7-mc Amplifiers, Schematic Diagram



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A4; FOR EXAMPLE, A4L1.
2. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.
3. VALUE OF A4R18 IS APPROXIMATELY 150 OHMS; EXACT VALUE IS DETERMINED AT TIME OF ASSEMBLY.

TP3045

Figure 4–8. Agc Circuit, Schematic Diagram

voltage, so that Q1 will only conduct when signals of approximately 10 μv or more are received at the antenna. R4 and R5 make up a voltage divider between 9.5 volts dc and ground. R3, part of the collector load for Q1, is connected to a point on the divider approximately 1.6 volts positive. This positive voltage provides the forward bias of Q2.

When the 1.7-mc second i-f signal, coupled to the base of Q1 from the fourth 1.7-mc amplifier, A3Q4, exceeds the delay bias, Q1 will conduct. When Q1 conducts, the voltage drop across R3 causes the collector of Q1 to become more negative with respect to the base of Q2 and also negative with respect to ground. The negative, pulsating d-c output from Q1 is coupled through an RC filter network consisting of C1, C2, and R6. The filtered output (negative electron tube agc voltage) is applied to r-f amplifier A1V1, first mixer A1V2, and first i-f amplifier A2V1. CR1, which is connected between the output of the RC filter and ground, acts as a d-c clamp and prevents the electron tube agc voltage from going positive when the input signal is too small to overcome the delay bias.

A portion of the output across R4 is coupled to the base of Q2, which is forward-biased and normally conducting with zero r-f signal input to the receiver. As the collector of Q1 goes more negative, due to increasing signal, the voltage on the base of Q2 goes more negative, thereby reducing the conduction of Q2. With the conduction of Q2 reduced, the voltage drop across R8 decreases and the collector of Q2 becomes more positive. This positive potential (transistor agc voltage) is d-c coupled to the base of the first 1.7-mc amplifier, A3Q1. The positive agc voltage reduces the emitter current, thereby decreasing the conduction of A3Q1. Decreased conduction of A3Q1 causes the base potential of A3Q2 to rise and it correspondingly decreases its conduction. When the conduction of A3Q1 and A3Q2 is reduced, the gain of the 1.7-mc i-f amplifiers is reduced proportionally.

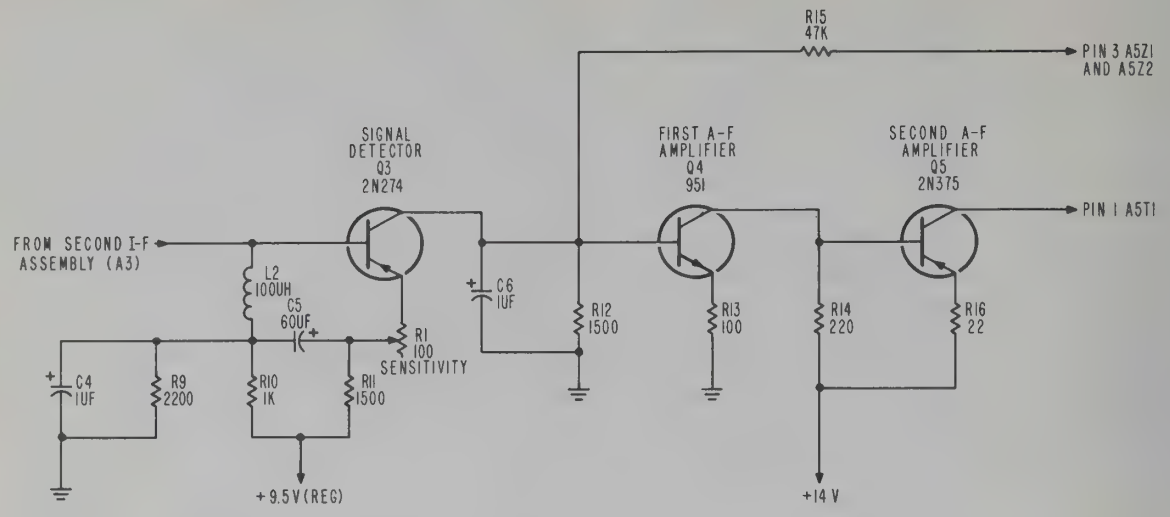
Signal Detector. The signal detector, Q3, is similar in operation to an electron tube grid-leak detector. In the electron tube, the demodulation takes place in the control grid-to-cathode portion and the amplification takes place in the control grid-to-plate portion. In Q3, demodulation takes place in the base-to-emitter portion and amplification takes place in the emitter-to-collector portion.

As shown in Figure 4–9, the 1.7-mc signal from the fourth 1.7-mc i-f amplifier, A3Q4, is applied to the base of Q3. Q3 is biased for normal class A operation. The 1.7-mc i-f signal is demodulated by the diode portion (base to emitter) of Q3. R-f choke L2 provides a high impedance to the input r-f signal, but permits the demodulated signal coupled by R1 and C5 to return to the base in a reflex action. C4 and C6 bypass the r-f component of the demodulated signal. R1, the sensitivity control, regulates the amount of audio degeneration of the detector and thereby controls the gain of the audio stages. R12 governs the operating characteristics of the d-c coupled stages and is selected to permit audio amplifiers Q4 and Q5 to operate in the class A region. Degenerative feedback from the output of A5T1 is coupled to the base of Q4 by R15. This feedback stabilizes the overall gain and minimizes distortion from the audio stages. Q3, Q4, and Q5 are d-c coupled to provide good low-frequency response at 90 and 150 cps. Emitter resistors R13 and R16 of Q4 and Q5, respectively, provide degeneration and therefore good a-c stability with low distortion. The voltage for Q5 is obtained by tapping into the filament string. Noise or hum appearing on the filament string does not intermix with the normal glide-slope signal due to the inherent hum-cancelling characteristic of the base-emitter connection. With the base-emitter connection, any hum on the filament string is applied to the base and emitter of Q5 in equal amounts; no signal due to hum appears at the collector of Q5.

4–10. METER ASSEMBLY.

The meter assembly, A5, is designed to accept glide-slope information from the audio amplifiers, convert the information to a corresponding d-c voltage, and couple the d-c voltage to the horizontal pointer circuit of the deviation indicator.

As shown in Figure 4–10, the audio output signal from the collector of the second audio amplifier, A4Q5, is connected to the primary of step-up output transformer T1. The audio signal from the secondary of T1 is fed to two parallel filters, Z1 and Z2. Z1 is a 90-cps series-parallel-resonant circuit that passes the 90-cps component of the audio signal and rejects the 150-cps component. Z2 is a 150-cps series-parallel-resonant circuit that passes the 150-cps component of the audio signal and rejects the 90-cps component. Potentiometer R1, which is connected between pin 4 of Z1 and pin 4 of Z2, is used to balance and compensate any variations in circuit and filter constants. With equal outputs of signal modulation of the input carrier, the circuit can be adjusted for equal output voltages from Z1 and Z2. The 90-cps output of Z1 is connected to one bridge of dual-bridge rectifier Z3. The 150-cps output of Z2 is connected to the other bridge. With equal amounts of 90- and 150-cps input modulation (aircraft on glide slope), the current output from each of the two bridges will be equal in magnitude. The direction of current flow, as determined by the orientation of the diodes contained in each of the bridges, will cause a voltage drop across R3 which is equal in magnitude to the voltage drop across R4, but of opposite polarity. With equal voltage drops across both resistors, no current will flow in the common leg between the bridges. Since the common leg is connected through the deviation indicator (150-0-150 milliammeter), the horizontal

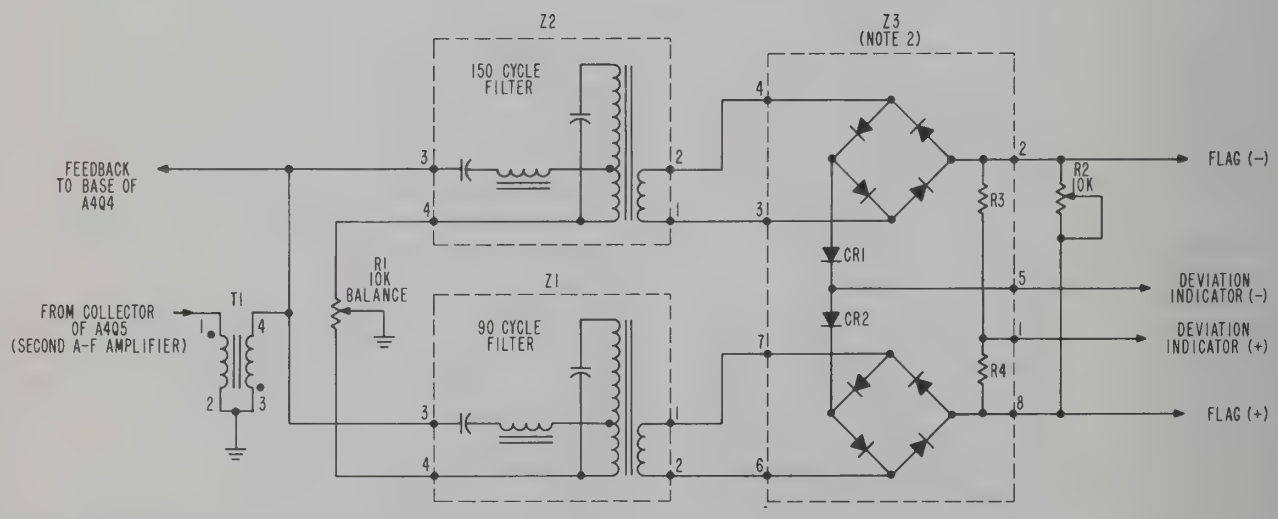


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A4; FOR EXAMPLE, A4L2.
2. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.
3. VALUE OF A4R12 IS APPROXIMATELY 1500 OHMS. EXACT VALUE IS DETERMINED AT TIME OF ASSEMBLY.

TP3047

Figure 4–9. Signal Detector and Audio Frequency Amplifiers, Schematic Diagram



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A5; FOR EXAMPLE, A5T1.
2. PARTS CONTAINED IN Z3 ARE NOT NORMALLY REPLACEABLE. REFERENCE DESIGNATIONS ASSIGNED TO PARTS CONTAINED IN Z3 ARE FOR INFORMATION ONLY.
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIER: K=1000.

TP3049

Figure 4–10. 90- and 150-cps Filters and Rectifiers, Schematic Diagram

pointer will remain centered. If either of the two modulations becomes dominant (aircraft above or below glide slope) the output of one of the bridges will be greater than the output of the other. The resulting potential is used to deflect the deviation indicator's horizontal pointer.

The horizontal pointer flag is used to indicate the presence or absence of usable glide-slope signals. The flag coil is connected in parallel with the series combination of R3 and R4. When a usable glide-slope signal is received, the flag swings out of sight from the effect of current flowing through its coil. In detail, when a usable glide-slope signal is received, a large difference in potential exists between the output of the 90-cps bridge and the 150-cps bridge. This difference in potential establishes a current flow in the parallel-connected flag coil, causing the flag to remain out of sight. The large difference in potential is present only when the aircraft is on the glide slope or in the area adjacent to it. If the aircraft is out of the range of the glide slope, or if either the 90-cps or 150-cps modulation is lost because of receiver or ground station malfunction, the difference in potential between the bridge outputs will be substantially reduced. A corresponding reduction in current flow through the meter coil will result and the flag will be either partially or totally visible.

CR1 and CR2 are connected in the flag loop to give the flag coil a nonlinear characteristic. This allows the flag to drop out rapidly on weak signals. Variable resistor R2 is used to adjust the sensitivity of the horizontal flag mechanism. R2 is connected in parallel with the horizontal flag coil of the deviation indicator and acts as a variable shunt across the coil. The sum of the output voltages of each of the bridge circuits applied to this parallel circuit produces a current flow through the flag coil and R2. Maximum flag sensitivity will result when R2 is set to the full counterclockwise position (minimum shunting). R2 is factory-adjusted so that the flag is just hidden when a 40-μv signal is coupled to the antenna.

4–11. HIGH-VOLTAGE POWER SUPPLY.

As shown in Figure 4–11, low-voltage dc from the associated control unit is connected through L1 to two 2N375 high-power transistors, Q1 and Q2. The transistors are connected in a self-excited multivibrator switching circuit. This circuit furnishes reversing-polarity, square-wave pulses to the primary of toroidal transformer T1. The secondary winding of T1 furnishes a square-wave output which is connected to a full-wave rectifier consisting of two 1N2071 silicon diodes, CR1 and CR2. The output of the rectifier, 115 volts dc, is fed through filter choke L2, filtered by C3, and then fed to the electron tube circuit. R7 and C5 provide a constant resistive load to the full-wave rectifier, improving the regulation of the +115 volts dc at low line-input voltages. Zener diode CR3 regulates the voltage tapped from the secondary of T1 to provide the regulated –18 volts dc necessary for the agc circuits. Zener diode CR4 regulates the 9.5-volt operating voltage to provide a constant voltage for the transistor circuits. R5 limits the current through CR4.

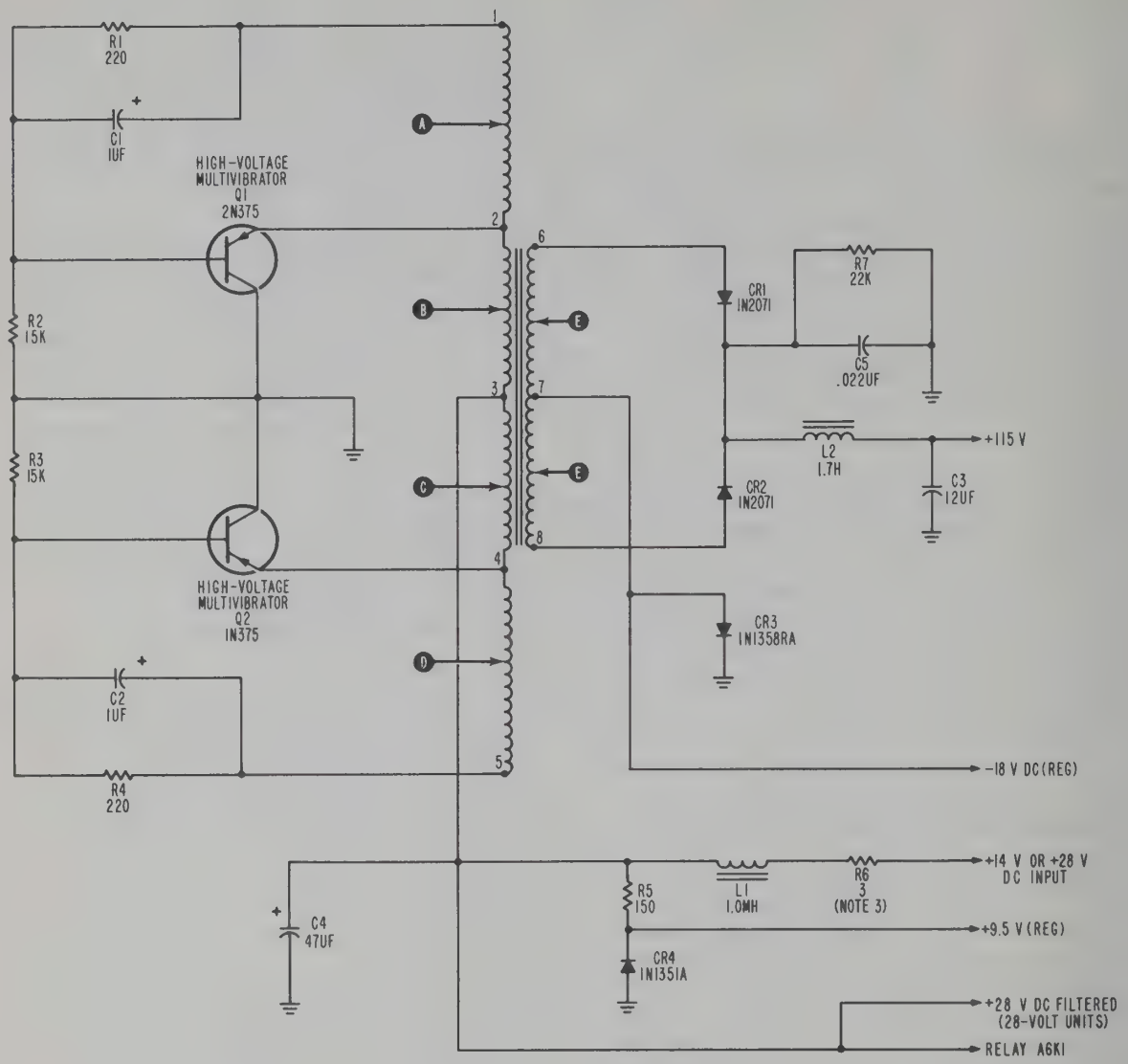
In detail, the multivibrator circuit consisting of Q1 and Q2 performs the same function as the vibrator in a vibrator power supply; that is, the low-voltage dc is alternately applied across each half of the primary winding. To follow one square-wave cycle, assume that at the instant the circuit is energized a slight imbalance in Q1 and Q2 causes more current to flow in winding C than in winding B of T1. The flux in the transformer core begins to change toward saturation in one direction at a linear rate, since the product of the rate of change of flux with respect to time and the number of the turns must equal the battery voltage (neglecting the small back voltage due to the IR drop).

The change in flux induces voltages in windings A and D, making them positive at pins 1 and 5. The base of Q2, therefore, becomes negative with respect to its emitter, and the base of Q1 becomes positive with respect to its emitter. Under these conditions, Q2 is at saturation (low resistance from emitter to collector) and Q1 is cut off (high resistance from emitter to collector).

When Q2 is conducting heavily, almost all of the input voltage appears across winding C and the flux in the core of the transformer increases until saturation occurs. When the core becomes saturated, the flux ceases to change. Consequently, the induced voltages in windings A and D drop to zero, causing Q2 to cut off and the current in winding C to decrease.

The decrease of current in winding C causes a decrease of flux in the core of the transformer. This change of flux induces voltages of such polarity in windings A and D that they become negative at pins 1 and 5. As a result, Q2 cuts off completely, Q1 conducts heavily, and current increases in winding B until saturation of the core occurs in the opposite direction. During this time, the voltages induced in windings A and D keep Q2 cut off and Q1 conducting. When the core of the transformer becomes saturated, the switching again takes place.

The switching action of the transistors continues to repeat. Current flows alternately in windings B and C, inducing a square-wave alternating voltage in winding E of the transformer.



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION. A7; FOR EXAMPLE, A7R1.

2. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.

3. RESISTOR A7R6 IS USED ONLY ON 28-VOLT UNITS.

TP3051

Figure 4–11. High-voltage Power Supply, Schematic Diagram

SECTION V

MAINTENANCE

5–1. INTRODUCTION.

This section contains maintenance information for the R-31A Receiver and includes a list of test equipment required for maintenance, removal and replacement procedures, lubrication information, system performance checks, trouble analysis information, alignment and adjustment procedures, and voltage, resistance, and stage gain measurements. Complete schematic and wiring diagrams of the units are included in Section VI.

WARNING

VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND MAY BE FATAL IF CONTACTED. OBSERVE ALL SAFETY PRECAUTIONS.

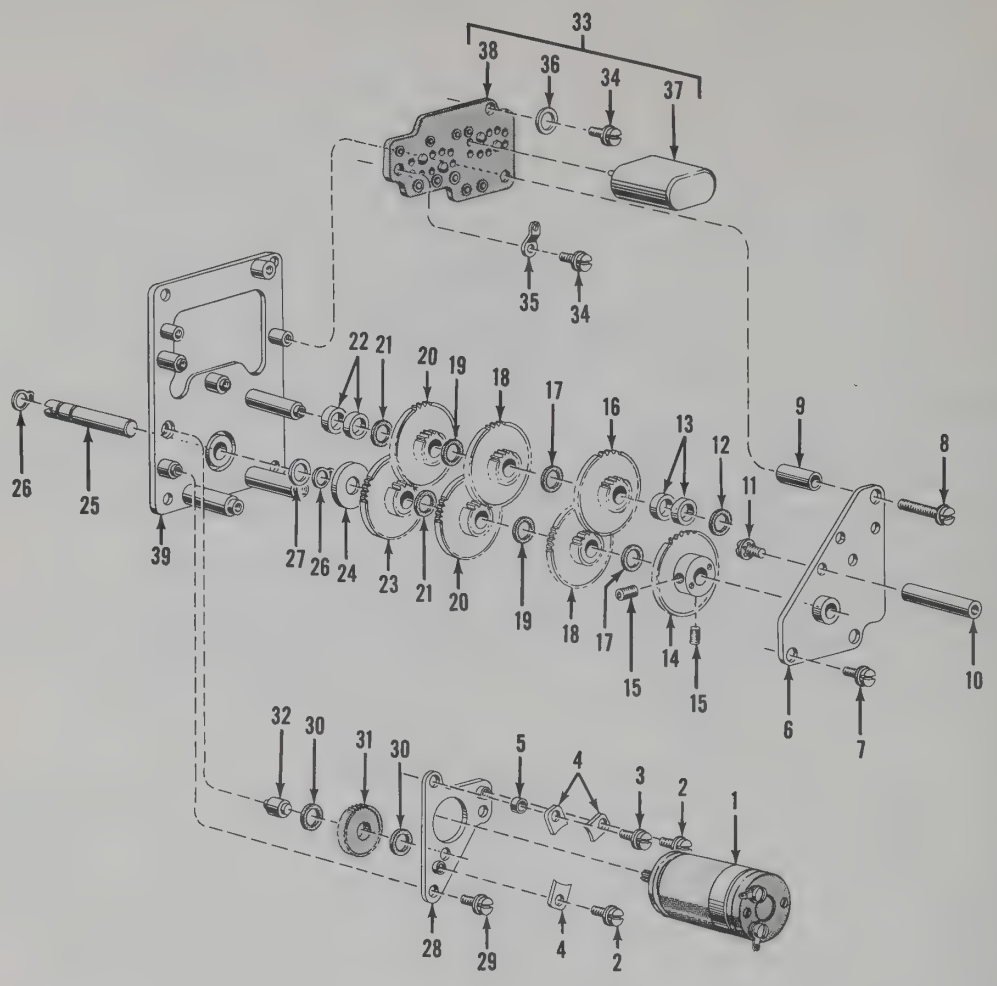
5–2. TEST EQUIPMENT.

Table 5–1 lists the test equipment required for maintenance of the R-31A Receiver. Equivalent test equipment may be substituted.

TABLE 5–1. TEST EQUIPMENT

Qty	Name	Designation	Characteristics
1	Attenuator	Hewlett-Packard Model 355A	50 ohm, 0-12 db, 1-db steps
1	Attenuator	Hewlett-Packard Model 355B	50 ohm, 0-120 db, 10-db steps
1	Bias Battery	—	3-volt dry cell
1	Capacitor	—	.01 μf
1	Capacitor	—	22 μf
1	Crystal Diode	1N34AG	—
1	Control Unit	ARC Type C-69A	Standard ARINC glide-slope control unit
1	Cross-pointer Meter	ARC-13310	Standard ARINC deviation indicator
1	Glide Slope Signal Generator	Boonton Radio Corp. Model 232-A	—
1	Microammeter[1]	Weston Model 301	150-0-150 μa
1	Milliammeter[1]	Weston Model 301	0-1 ma
1	Oscilloscope	Tektronix Model 545	—
1	Primary Power Supply	—	14- or 28-volt dc rectifier or storage battery
2	Resistor	—	1000 ohms
1	Resistor	—	47 ohms
1	Signal Generator	Measurements Corp. Model 65-B	—
1	Sweep Generator[2]	Jerrold Model 900	—
1	Vacuum Tube Voltmeter	Ballantine Model 300	—
1	Vacuum Tube Voltmeter	Hewlett-Packard Model 410B	—

[1] Internal resistance to be 1000 ohms; if not, modify by adding resistance in series as needed.
[2] Optional Equipment. Refer to *First I-f Alignment Without a Sweep Generator* and *R-f Alignment Without a Sweep Generator* in paragraph 5–7.



Index No.	Name	ARC Part No.
1	Motor	18800-0014 18801-0028
2	Screw	103-0012
3	Screw	103-0020
4	Clamp	17963
5	Spacer	12793
6	Plate	22835
7	Screw	503-0014
8	Screw	503-0048
9	Sleeve	19666
10	Post	21491
11	Screw	503-0014
12	Washer	7117
13	Spacer	5591
14	Gear	24804
15	Setscrew	303-0008
16	Gear	24799
17	Washer	7117
18	Gear	24799
19	Washer	7117
20	Gear	24799
21	Washer	7117

Index No.	Name	ARC Part No.
22	Spacer	5591
23	Gear	24803
24	Spacer	17899
25	Shaft	21548
26	Retaining ring	17742
27	Washer	7117
28	Plate	22836
29	Screw	503-0014
30	Washer	17935
31	Gear	17959
32	Shaft	17958
33	Printed circuit	22978-0014 22978-0028
34	Screw	503-0014
35	Terminal	17166
36	Washer	7709
37	Relay	22584-0014 22584-0028
38	Printed circuit	22977-0014 22977-0028
39	Plate	22837

TP3053

Figure 5–1. Channel Selector A6, Exploded View

5–3. REMOVAL AND REPLACEMENT PROCEDURES.

Caution

To prevent damaging the miniature parts of the plug-in assemblies, handle each assembly by the external framework only.

General. The R-31A may be serviced in the field; however, replacement parts must be identical to the original parts to ensure optimum performance. After replacement of any part that affects the LC constant of a circuit, a complete alignment of that circuit is recommended. The alignment is necessary because circuit operation is affected by the gain of the tube and transistor sections and by the tolerance of the parts. When parts that do not directly affect the LC constant of a circuit are replaced, a performance test as outlined in paragraph 5–5 should be performed to ensure satisfactory operation. If operation is unsatisfactory, realign the circuit by performing the applicable procedure outlined in paragraph 5–7.

Because of the frequencies present in the preselector (up to 335.0 mc), location and spacing between parts and leads are critical. When it is necessary to replace parts in the preselector, orient the replacement parts and leads as much like the original installation as possible (see Figure 6–3).

If it is necessary to replace A1C5 or A1C8, perform the alignment procedure for A1C5 and A1C8 outlined in paragraph 5–7.

Note

Except for the preselector assembly, A1, unit designations for parts contained in the R-31A are engraved on the printed-circuit boards used to mount the parts. Unit designations and location of parts contained in the preselector are shown in Figure 6–3.

Removal of Dust Covers. The receiver dust cover and the power supply dust cover (adjacent to the connector) are each secured to the main chassis by a single Dzus fastener. Remove the power supply dust cover before removing the receiver dust cover. The channel-selector dust cover on the front of the receiver is secured to the main chassis by a single Sems-type screw.

Removal and Replacement of Power Supply Assembly A7. To remove the power supply, remove the four screws (one in each corner) that hold it to the main chassis, and pull the assembly off. To replace the power supply, reverse the procedure.

Note

The power supply is voltage-sensitive. Voltage rating of the assembly must match the voltage of the aircraft primary power supply.

Removal and Replacement of Channel Selector Assembly A6. To remove the channel selector, remove the four screws (one in each corner) holding it to the main chassis and pull the assembly off. No special procedures are required to disassemble the channel selector; however, to facilitate disassembly and to help identify replaceable parts, refer to Figure 5–1. To replace the assembly, manually rotate the gears until the slotted output shaft of the channel selector engages the rotary switch shaft, then reinstall the four screws previously removed. Install the shorter pair of screws in the top pair of holes.

Note

The channel selector is voltage-sensitive. Voltage rating of the assembly must match the voltage of the aircraft primary power supply.

Removal and Replacement of Preselector Assembly A1. The preselector is held in place by two screws through the top of the chassis, a screw bonding the preselector frame to the main printed-circuit board, and three screws through the front panel of the receiver. To remove the preselector, unsolder the shielded wire that connects it to the first i-f assembly, A2, and remove the six screws that hold the assembly in place. Advance the crystal drum to its blank position by manually rotating the channel-selector gear train. Lift the preselector from the receiver case. To replace the preselector, reverse the procedure.

Note

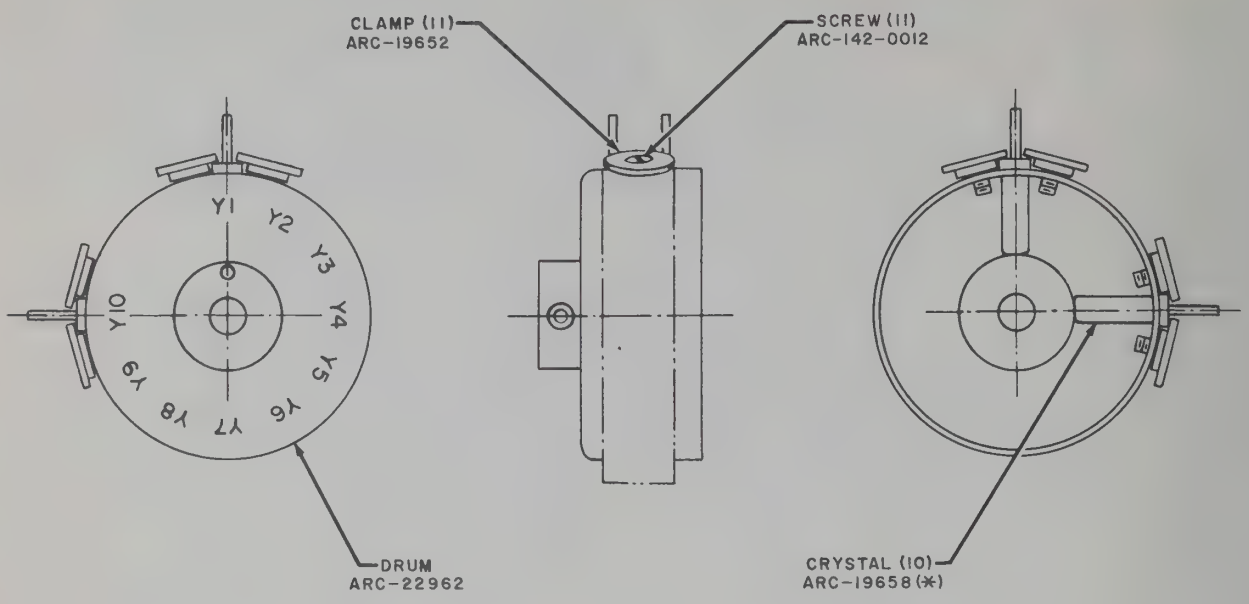
The metal cover plates on each side of the preselector can be removed without removing the preselector from the chassis. Do not remove the preselector from the chassis unnecessarily.

Removal and Replacement of Printed-circuit Assemblies. To remove any of the four printed-circuit assemblies, remove the two flat head screws (one at each end) that secure the assembly to the main chassis. Then, using a screwdriver in each of the two appropriate slots in the main chassis, apply force upward until the jacks on the edge of the printed-circuit board are freed from the mating pins on the main chassis. Remove the screwdrivers and lift the assembly out. To replace the assembly, slide it in place until the pins on the main chassis fully engage the jacks on the edge of the printed-circuit board. Secure the assembly to the main chassis with the two flat head screws removed previously.

Note

Before removing the first i-f assembly, A2, unsolder the shielded wire that connects it to the preselector.

Replacement of Electron Tubes. Five subminiature electron tubes are used in the R-31A. One of the tubes is part of the first i-f assembly, A2. The four remaining tubes are part of the preselector, A1. The tube in the first i-f



*FOR COMPLETE PART NUMBER, REPLACE ASTERISK WITH FOUR-DIGIT NUMBER LISTED IN TABLE BELOW.

Location	ARC Part No.	Crystal Frequency Megacycles	Glide-Slope Frequency Megacycles
Y1	19658-4993	49.933	329.3 or 329.6
Y2	19658-5003	50.033	329.9 or 330.2
Y3	19658-5013	50.133	330.5 or 330.8
Y4	19658-5023	50.233	331.1 or 331.4
Y5	19658-5033	50.333	331.7 or 332.0
Y6	19658-5043	50.433	332.3 or 332.6
Y7	19658-5053	50.533	332.9 or 333.2
Y8	19658-5063	50.633	333.5 or 333.8
Y9	19658-5073	50.733	334.1 or 334.4
Y10	19658-5083	50.833	334.7 or 335.0

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Figure 5–2. Location of Quartz Crystals

assembly is accessible after removing the dust covers from the power supply and main chassis. To gain access to the four tubes in the preselector, the metal cover plate on each side of the preselector must be removed, in addition to the dust covers. The flexible leads of each tube are soldered directly to terminal points. When replacing a tube, the new tube leads should be the same length and oriented as nearly like the original installation as possible. Do not precut the leads before installation. Use a minimum amount of solder during installation. Table 5–2 lists the tubes used in the R-31A. The table contains information on the general location of each tube and a reference to the wiring diagram illustrating the part.

Replacement of Transistors and Crystal Diodes. The R-31A contains 13 transistors. Ten of these are soldered directly into the circuits; the remaining three are plug-in type transistors. Two of these transistors are used in the power supply assembly, A7, and one is used in the af-agc assembly, A4. Of the 15 crystal diodes in the receiver, ten are contained in the dual-bridge rectifier, A5Z3; one diode is in the af-agc assembly, A4; the remaining four diodes, two of which are stud-mounted Zener diodes, are in the power supply, A7.

To replace any of the ten crystal diodes in A5Z3, first remove the meter assembly, A5, from the main chassis. Then remove the 12 nuts and five Sems-type screws used to secure the printed-circuit board and attached parts to the aluminum frame. Remove the screw from the top of A5Z3 and lift the cover to expose the crystal diodes. Reverse this procedure to reassemble the parts.

Before soldering a transistor or crystal diode, disconnect the power source and make sure the soldering iron is grounded. When soldering, hold a pair of pliers between the solder joint and the semiconductor. The pliers form a heat sink and prevent excessive heat from damaging the part. Always use a hot, small-wattage iron (35 watts or less) when soldering. Always check polarity and route the semiconductor leads as nearly like the original as possible. Table 5–2 lists the transistors and crystal diodes contained in the R-31A. The table contains information on the general location of each semiconductor and a reference to the wiring diagram illustrating the part.

Replacement of Quartz Crystals. The two crystals, A2Y1 and A2Y2, associated with the second oscillator in the first i-f assembly, A2, are soldered in place. The location of these crystals is illustrated in Figure 6–4. The ten crystals associated with the first oscillator are mounted around the periphery of a rotatable drum, as shown in Figure 5–2. To remove a crystal, loosen the retaining screw and clamp on each side of the crystal and lift the crystal out. To replace a crystal, reverse the procedure. To engage the wiper contacts properly, the crystal pins must be straight.

TABLE 5–2. LOCATION OF TUBES, TRANSISTORS, AND CRYSTAL DIODES

Ref. Desig.	Type	ARC Part No.	Wiring Diagram Figure No.
A1V1	5899	700-0132	6–3
A1V2	5899	700-0132	6–3
A1V3	6021	700-0136	6–3
A1V4	5718	700-0122	6–3
A2Q1	2N384	22636	6–4
A2Q2	2N384	22636	6–4
A2V1	5899	700-0132	6–4
A3Q1	2N274	22541	6–5
A3Q2	2N274	22541	6–5
A3Q3	2N274	22541	6–5
A3Q4	2N274	22541	6–5
A4CR1	1N462	17633	6–6
A4Q1	2N1150/904	20638	6–6
A4Q2	2N1150/904	20638	6–6
A4Q3	2N274	22541	6–6
A4Q4	951	18573	6–6
A4Q5	2N375	22289	6–6
A7CR1	1N2071	8931-0601	6–9
A7CR2	1N2071	8931-0601	6–9
A7CR3	1N1358RA	8934-0200	6–9
A7CR4	1N1351A	8923-0100	6–9
A7Q1	2N375	22289	6–9
A7Q2	2N375	22289	6–9

5–4. LUBRICATION.

The R-31A Receiver should be lubricated in accordance with the information given in Figure 5–3. The gears and bearing surfaces of the C-88A Control Unit or CC-12A Custom Control Unit should be lubricated in accordance with the information in Figure 5–4. Before applying new lubricant to any surface, remove the old lubricant.

5–5. SYSTEM PERFORMANCE CHECKS.

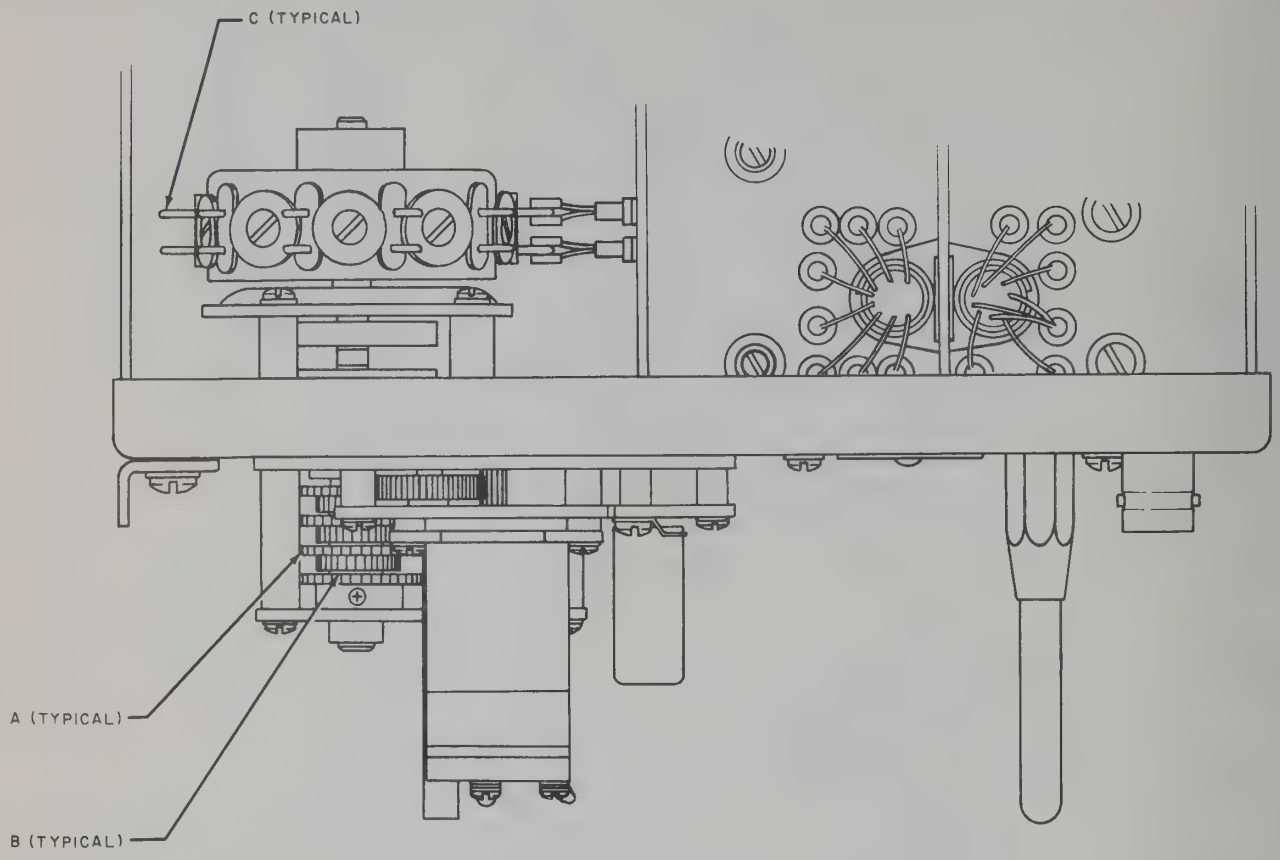
General. Check the accuracy and performance of the R-31A periodically or whenever abnormal operation is indicated or suspected. Table 5–3 outlines the procedures, which may be performed separately, for checking performance of the R-31A. Table 5–1 lists the required test equipment. Figure 5–6 illustrates the bench test interconnections necessary for performing the procedures.

Test Conditions. Unless otherwise specified, the following test conditions apply:

Input Voltage. 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model) as measured on the test-setup voltmeter.

Receiver Load. Three parallel-connected, 1000-ohm deviation indicators (333 ohms total) and two parallel-connected 1000-ohm flag current meters (500 ohms total).

Warmup. At least 5 minutes prior to measurements.



Point of Lubrication	Part to be Lubricated	Lubrication Period	Kind of Lubricant	Method of Application
A	Gear Teeth	500 hours	Aeroshell No. 7 Grease	Apply thin coat to gear teeth with artist's brush.
B	Bearing Surfaces	500 hours	Aeroshell No. 7 Grease	Apply thin coat to bearing surfaces with artist's brush.
C	Crystal Pins	500 hours	Dow-Corning DC-510 Silicone Fluid	Apply small amount to crystal pins with artist's brush.

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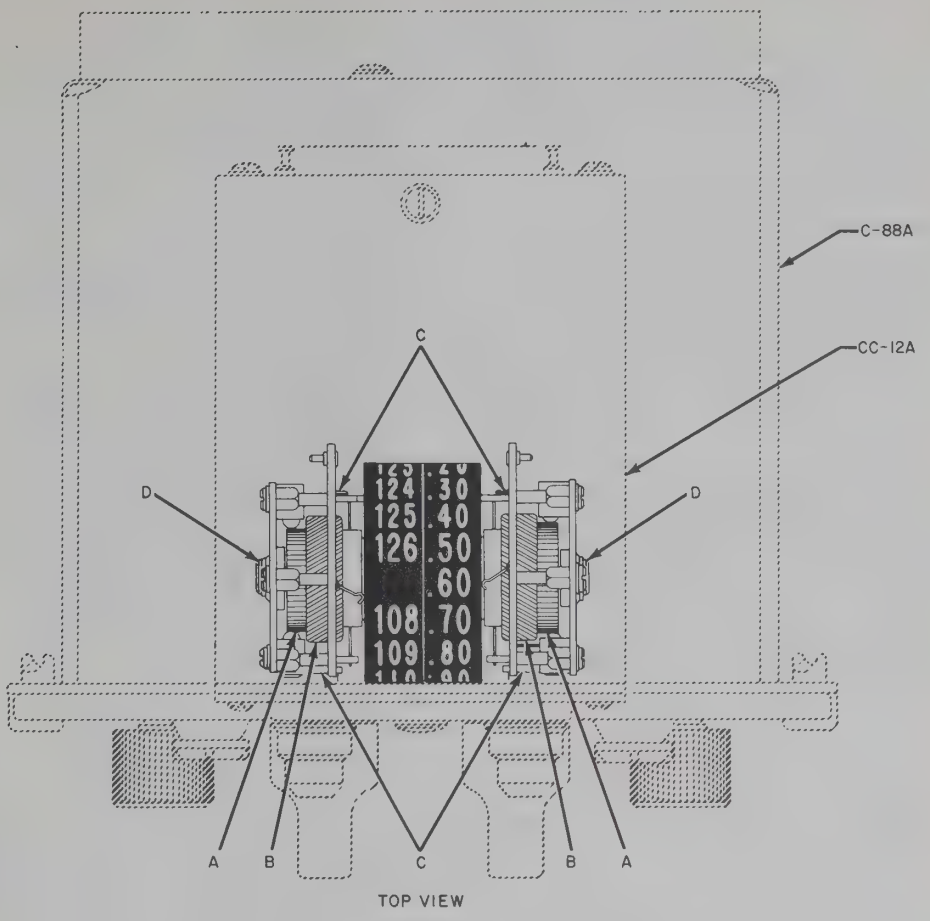
Figure 5–3. R-31A Receiver, Lubrication Points



Caution

Keep oil and grease away from spring contacts and printed circuit contact plates, otherwise intermittent contact may result.

Point of Lubrication	Part to be Lubricated	Lubrication Period	Kind of Lubricant	Method of Application
A	Detent Gear	500 hours	Aeroshell No. 7 Grease	Apply thin coat to gear teeth with artist's brush.
B	Bevel Gear	500 hours	Aeroshell No. 7 Grease	Apply thin coat to gear teeth with artist's brush.
C	Control Shaft Bearing	500 hours	Pioneer No. 10 Oil	Invert unit and apply one drop to each bearing with a sharp-pointed tool.
D	Drum Shaft Bearing	500 hours	Pioneer No. 10 Oil	Apply one drop to each bearing.

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Figure 5–4. C-88A Control Unit and CC-12A Custom Control Unit, Lubrication Points

TABLE 5–3. R-31A RECEIVER PERFORMANCE CHECKS

Step	Procedure	Normal Indications
	PRELIMINARY PROCEDURE	
	Note Unless otherwise noted, all controls, switches, knobs, and indicators mentioned in the following procedures are mounted on the Boonton Radio Model 232-A Glide Slope Signal Generator.	
1	Remove dust covers from R-31A. Interconnect R-31A and test equipment as shown in Figure 5–6.	None.
2	Turn on primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set toggle switch on C-69A Control Unit to REC. Set POWER ON-HEATER switch to POWER ON. Let R-31A and test equipment warm up for 5 minutes before proceeding.	R-31A tube filaments light.
3	Set CARRIER knob to RF and MOD control to 90-150~. Rotate CARRIER ADJUST knob until pointer of CARRIER MONITOR meter positions at red line. Set DB TONE RATIO switch to CAL 90~ and meter scale switch to 0-100%. Rotate MOD LEVEL control to obtain 45% modulation on PERCENT MODULATION meter. If 150-cps modulation is desired, perform the procedure substituting CAL 150~ for CAL 90~.	None.
	Note When performing the following procedures, adjust CARRIER ADJUST knob as necessary to position CARRIER MONITOR meter pointer at red line.	
	HIGH- AND LOW-VOLTAGE TESTS	
1	Perform Steps 1 and 2 of the *Preliminary Procedure* outlined in this table.	None.
2	Connect Hewlett-Packard Model 410B vtvm (300-volt range) between pin 24 of connector J2 and chassis ground.	Meter reads between 95 and 125 volts dc.
3	Connect Hewlett-Packard Model 410B vtvm (30-volt range) between pin 25 of connector J2 and chassis ground.	Meter reads between –16 and –21 volts dc.
4	Connect Hewlett-Packard Model 410B vtvm (30-volt range) between pin 23 of connector J2 and chassis ground.	Meter reads between 9 and 10.5 volts dc.
	RECEIVER CHANNELING	
1	Perform Steps 1 and 2 of the *Preliminary Procedure* outlined in this table.	As noted.
2	Operate C-69A Control Unit channel-selector switch to select each channel. Observe crystal drum for correct positioning of crystals. Listen for operation of A-B relay (A2K1) when switching between adjacent channels such as 329.3 and 329.6 mc.	Crystal drum indexes to crystal corresponding to selected frequency (see Figure 5–1). A2K1 will energize when an odd-megacycle frequency is selected and deenergize when an even-megacycle frequency is selected.
3	Reduce primary voltage to 22 volts (for 28-volt model) or 11 volts (for 14-volt model). Set C-69A channel-selector switch to each odd frequency, in an ascending order (for example, 329.3, 329.9, 330.5). Observe crystal drum for correct positioning of crystals.	Crystal drum indexes to crystal corresponding to selected frequency but with reduced speed.

TABLE 5–3. R-31A RECEIVER PERFORMANCE CHECKS—Continued

Step	Procedure	Normal Indications
	RECEIVER CHANNELING—Continued	
4	Increase primary voltage to 31 volts (for 28-volt model) or 15.5 volts (for 14-volt model). Set C-69A channel-selector switch to each odd frequency, in a descending order (for example, 334.7, 334.1, 333.5). Observe crystal drum for correct positioning of crystals.	Crystal drum indexes to crystal corresponding to selected frequency but at higher speed with no tendency to overshoot.
	HORIZONTAL POINTER CENTERING TEST	
1	Perform Steps 1, 2, and 3 of the *Preliminary Procedure* outlined in this table.	None.
2	Set DB TONE RATIO switch to 0. Set FREQUENCY control and C-69A Control Unit channel-selector switch to 332.0 mc. Adjust OUTPUT LEVEL to 200 μv and observe deviation current on 150-0-150 microammeter.	Deviation current is 0 μa.
3	Set FREQUENCY control and C-69A channel-selector switch to each of the 20 glide-slope frequencies in succession. As each frequency is selected, vary the OUTPUT LEVEL control from 100 to 30,000 μv and observe deviation current on 150-0-150 microammeter.	Deviation current does not exceed 3.9 μa of either polarity over this range.
	RECEIVER SENSITIVITY	
1	Perform Steps 1, 2, and 3 of the *Preliminary Procedure* outlined in this table.	None.
2	Set FREQUENCY control and C-69A Control Unit channel-selector switch to 332.0 mc. Set DB TONE RATIO switch to the left 2.0 position (90-cps modulation predominant). Set OUTPUT LEVEL to 700 μv and observe deviation current on 150-0-150 microammeter.	Deviation current is 78 μa.
3	Set OUTPUT LEVEL to 40 μv and observe deviation current on 150-0-150 microammeter.	Deviation current is at least 46.8 μa.
4	Set OUTPUT LEVEL to 14,000 μv and observe deviation current on 150-0-150 microammeter.	Deviation current is from 66.3 to 81.9 μa.
5	Set DB TONE RATIO switch to the right 2.0 position (150-cps modulation predominant). Set OUTPUT LEVEL to 700 μv and observe deviation current on 150-0-150 microammeter.	Deviation current is 78 μa.
	HORIZONTAL POINTER FLAG TEST	
1	Perform Steps 1, 2, and 3 of the *Preliminary Procedure* outlined in this table.	None.
2	Set FREQUENCY control and C-69A Control Unit channel-selector switch to 332.0 mc. Set OUTPUT LEVEL to 700 μv. Set DB TONE RATIO to CAL 90~ and observe horizontal pointer flag of ARC-13310 Cross-pointer Meter.	Horizontal pointer flag appears.
3	Set DB TONE RATIO switch to CAL 150~, and leaving OUTPUT LEVEL at 700 μv, observe horizontal pointer flag.	Horizontal pointer flag appears.
4	Set DB TONE RATIO switch to the left 2.0 position (90-cps modulation predominant). Vary OUTPUT LEVEL from 40 to 30,000 μv and observe cross-pointer meter.	Horizontal pointer flag does not appear.

TABLE 5–3. R-31A RECEIVER PERFORMANCE CHECKS—Continued

Step	Procedure	Normal Indications
	HORIZONTAL POINTER FLAG TEST—Continued	
5	Adjust OUTPUT LEVEL until deviation current on 150-0-150 microammeter equals 39 μa. Observe horizontal pointer flag.	Horizontal pointer flag appears (flag need not be in full view).
6	Set DB TONE RATIO switch to the right 2.0 position (150-cps modulation predominant). Vary OUTPUT LEVEL from 40 to 30,000 μv and observe cross-pointer meter.	Horizontal pointer flag does not appear.
7	Adjust OUTPUT LEVEL until deviation current on 150-0-150 microammeter equals 39 μa. Observe horizontal pointer flag.	Horizontal pointer flag appears (flag need not be in full view).
8	Adjust MOD LEVEL control to obtain 22.5% modulation on PERCENT MODULATION meter. Set DB TONE RATIO switch to 0. Set OUTPUT LEVEL to 700 μv and observe horizontal pointer flag.	Horizontal pointer flag appears (flag need not be in full view).
	AGC OPERATION	
1	Perform Steps 1, 2, and 3 of the *Preliminary Procedure* outlined in this table.	None.
2	Set FREQUENCY control and C-69A Control Unit channel selector switch to 332.0 mc. Set DB TONE RATIO switch to the left 2.0 position (90-cps modulation predominant). Vary OUTPUT LEVEL from 700 to 14,000 μv and observe deviation current on 150-0-150 microammeter.	Deviation current is from 68 to 82 μa under all conditions.

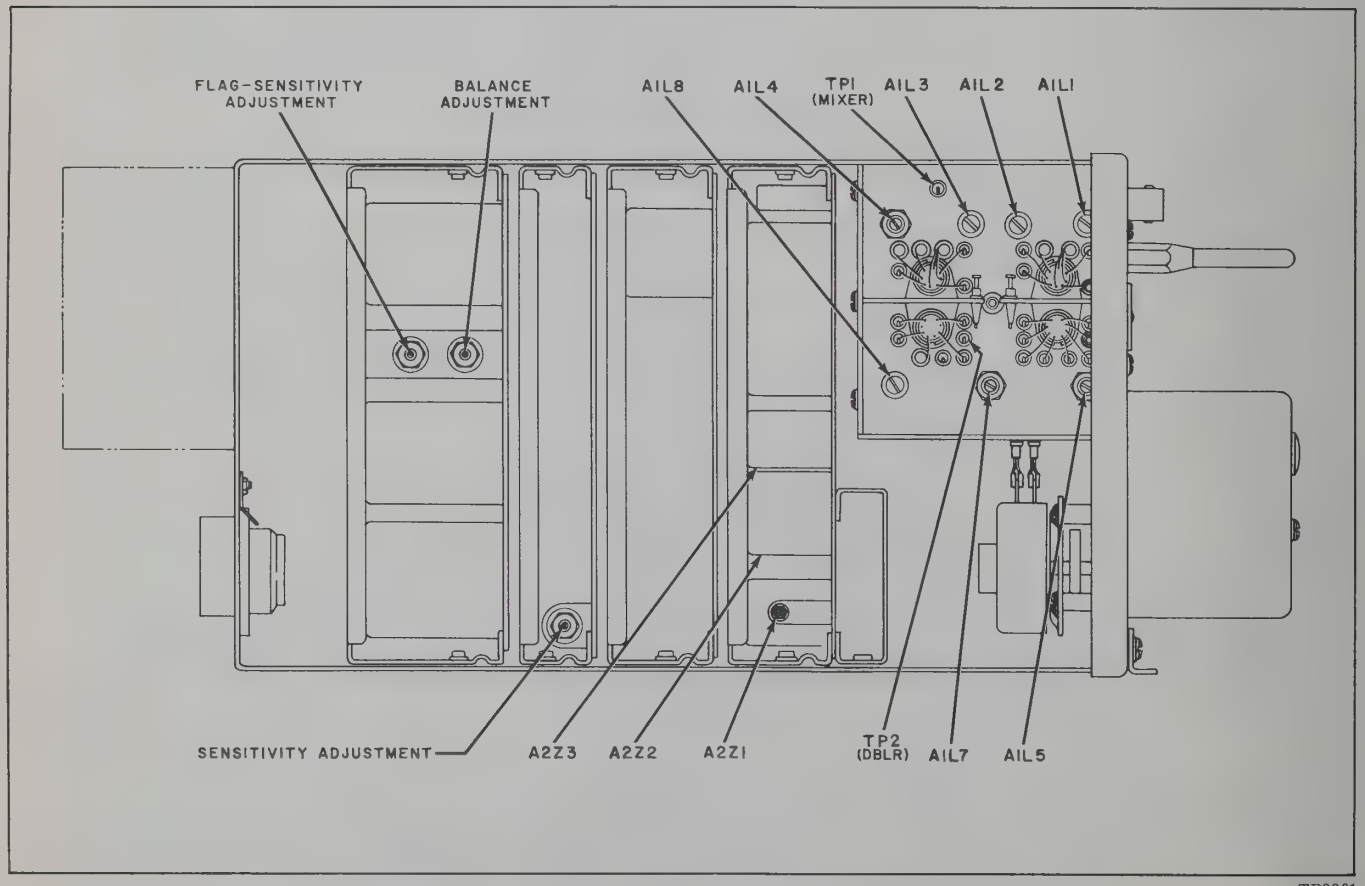

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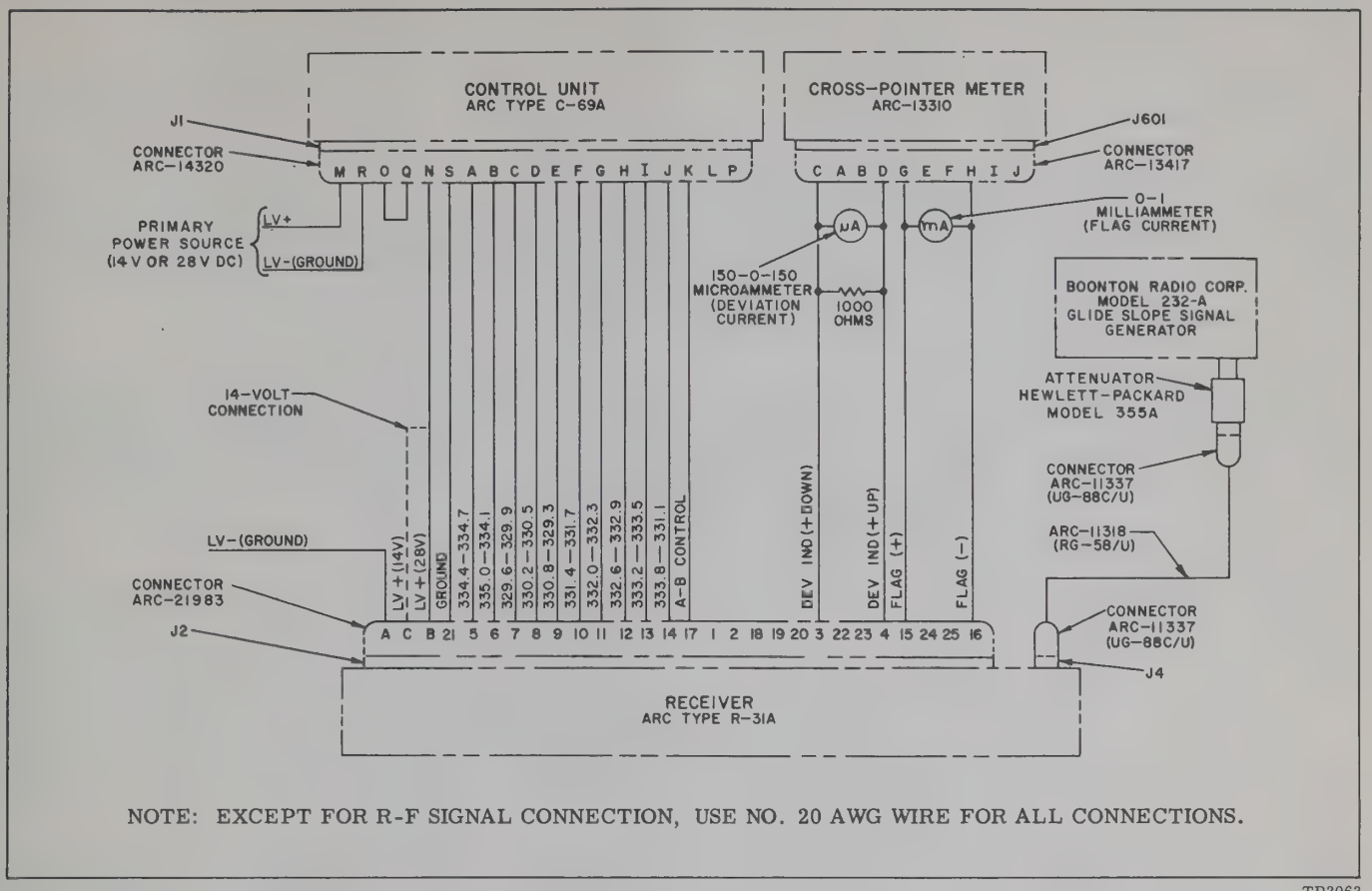
Figure 5–5. R-31A Receiver, Alignment and Adjustment Points



NOTE: EXCEPT FOR R-F SIGNAL CONNECTION, USE NO. 20 AWG WIRE FOR ALL CONNECTIONS.

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Figure 5–6. Bench Test Interconnection Diagram for R-31A Receiver with C-69A Control Unit

5–6. TROUBLE ANALYSIS.

General. Trouble-shooting based on the use of voltage and stage gain measurements will help to determine which stage is at fault and which part within the stage is producing the trouble. Circuit trouble-shooting based on the use of resistance measurements should be conducted only on the electron tube stages of the R-31A. Resistance measurements of transistorized stages are not recommended because they are not a true indication of the resistance when the circuit is in operation. In addition, indiscriminate use of an ohmmeter on a transistorized circuit could cause damage if the safe voltage limit is exceeded. Resistance measurements of individual parts may be made if the transistors are removed from the circuit containing the part.

Trouble-shooting Installed Equipment. A malfunction in the glide-slope system can be isolated to installation, instrumentation, or the R-31A Receiver. Two of these categories, installation and instrumentation, can be eliminated while the equipment is installed in the aircraft. If the R-31A is totally inoperative, first check the supply voltage. Presence of supply voltage can be determined by turning the R-31A on, using the C-69A Control Unit or VOR-localizer control unit. If the R-31A is controlled by a C-69A, channel the receiver through all the channels. If the R-31A is controlled by the same control unit as the localizer receiver, tune through the frequency range of 108.0 to 112.0 mc. By channeling the R-31A through the twenty channels, the channeling mechanism should run and stop after each change of frequency. This procedure is used to check wiring to the control circuits. If the R-31A operates normally in all previous checks, check the antenna, coaxial fittings, and coaxial leads. If the trouble is not located, remove the unit for bench check. Remove the dust covers from the R-31A and inspect the interior for obvious signs of damage. If necessary, interconnect the R-31A and test equipment as shown in Figure 5–6 and perform the system performance checks outlined in Table 5–3.

Trouble Analysis Chart. Table 5–4 lists the symptoms of some possible troubles, an analysis to localize the trouble, and the procedure that should be used to verify the analysis. Use of the table will help to localize the source of trouble, following which a point-by-point check may be made to determine the faulty part. For further assistance in localizing trouble, refer to the circuit theory discussion in Section IV and to the schematic and wiring diagrams in Section VI.

TABLE 5–4. TROUBLE ANALYSIS CHART

Symptom	Analysis	Procedure
TUNING AND CHANNEL SELECTION		
Channel-selector motor runs continuously.	Motor will normally run until ground-seeking circuit finds ground, causing A6K2 to energize, which removes the voltage from the motor. Anything that interrupts this sequence will cause this trouble. For example: A6K2 open, faulty contact on A6K2, or broken ground lead on switch A8S1.	Remove power from R-31A. Using an ohmmeter, check continuity of ground-seeking circuit. Refer to Figure 4–2 for functional information and Figures 6–1, 6–2, and 6–8 for point-to-point wiring information.
Channel-selector motor will not run on any position of channel selector switch.	Voltage is applied to the motor through the normally closed contacts of A6K2. Any circuit condition that causes A6K2 to remain energized at all times or prevents voltage from reaching A6K2 will produce this result. For example: No voltage applied to R-31A, or damaged pins on connector A8J2.	Check for voltage on the motor terminals. If voltage is present, check for binding of gears or defective motor. If voltage is absent, check operation of A6K2 and wiring from power supply to motor.
R-31A operative on even frequencies, inoperative on odd frequencies.	On odd frequencies, ground is applied to A6K1 through the control unit. When A6K1 energizes, ground is connected to A2K1, energizing this relay. When A2K1 is energized, crystal A2Y2, which provides the fundamental for the second injection frequency on odd-megacycle frequencies, is connected in the circuit. A2Z3, A2Y2, or any part associated with the switching sequence could be at fault.	Check alignment of A2Z3 as noted in paragraph 5–7. If R-31A is aligned properly, set channel-selector switch to several odd glide-slope frequencies. Check A2K1 and A6K1 at each frequency; they should be energized. If relays are functioning properly, check A2Y2 (31.4 mc). If relays are not functioning properly, check wiring from control unit to A6K1.
R-31A operative on odd frequencies, inoperative on even frequencies.	On even frequencies, crystal A2Y1, which provides the fundamental for the second injection frequency on even-megacycle frequencies, is connected into the circuit through the normally closed contacts of A2K1. A faulty crystal, detuned A2Z3, defective contacts on A2K1, or anything that could cause A2K1 to remain energized at all times will cause this trouble.	Check alignment of A2Z3 as noted in paragraph 5–7. If R-31A is aligned properly, set channel-selector switch to several even glide-slope frequencies. Check A2K1 and A6K1 at each frequency; they should be deenergized. If relays are functioning properly, check A2Y1 (28.3 mc). If relays are not functioning properly, check wiring from control unit to A6K1.
R-31A inoperative on two adjacent frequencies. All other frequencies normal.	Each of the ten crystals mounted on the rotatable turret is used to control a pair of glide-slope frequencies. If one of these crystals is defective, the two adjacent frequencies controlled by the defective crystal will be inoperative.	Refer to Figure 5–2 to determine which crystal is faulty. Replace the defective crystal.
R-F, I-F, AND AUDIO CIRCUITS		
R-31A inoperative, high-voltage normal, tubes lighted, agc normal.	Since proper agc action is dependent upon the operation of r-f and i-f stages, the trouble exists in the audio circuits (af-agc assembly A4 or meter assembly A5).	Perform the applicable voltage and stage gain measurements shown in Figure 5–12 and Table 5–5, respectively.
R-31A inoperative, high-voltage normal, tubes lighted, agc abnormal.	Correct functioning of the r-f and i-f stages is necessary to develop agc voltage. Since the R-31A is inoperative and agc voltage is abnormal, the trouble exists in either the r-f or i-f stage.	Perform the applicable voltage, resistance, and stage gain measurements shown in Figures 5–11, 5–12, and Table 5–5, respectively.
Wide variations in deflection current are noted as signal level is increased. (Agc circuit inoperative.)	The 1.7-mc output of the second i-f amplifier, A3, is used to drive an agc detector-amplifier, A4Q1. The output of A4Q1 is further amplified by A4Q2. Any defective part in either of these stages or in the circuit used to couple A3Q4 to A4Q1 will immobilize the agc and cause this trouble.	Perform the applicable voltage and stage gain measurements shown in Figure 5–12 and Table 5–5, respectively.

TABLE 5–4. TROUBLE ANALYSIS CHART—Continued

Symptom	Analysis	Procedure
	INDICATOR CIRCUITS	
Horizontal pointer deflects up when aircraft is below or above the glide slope. Flag visible at all times.	At points above the glide slope the 90-cps modulation is predominant; at points below the slope the 150-cps modulation is predominant. Since the horizontal pointer always deflects up (indicating a predominance of 150-cps modulation), either A5R1 is misadjusted or some part associated with the 90-cps portion of the modulation is faulty.	Check adjustment of A5R1. If A5R1 is adjusted correctly, apply a 25-μv, 90-cps only, 30% modulation, 332.0-mc glide-slope signal to the antenna input of the R-31A. Check the output between pins 3 and 4 of J2; the output should be approximately 90 μa. Check 90-cps filter A5Z2 and parts in 90-cps portion of dual-bridge rectifier A5Z3.
Horizontal pointer deflects down when aircraft is above or below the glide slope. Flag visible at all times.	At points below the glide slope the 150-cps modulation is predominant; at points above the slope the 90-cps modulation is predominant. Since the horizontal pointer always deflects down (indicating a predominance of 90-cps modulation), either A5R1 is misadjusted or some part associated with the 150-cps portion of the modulation is faulty.	Check adjustment of A5R1. If A5R1 is adjusted correctly, apply a 25-μv, 150-cps only, 30% modulation, 332.0-mc glide-slope signal to the antenna input of the R-31A. Check the output between pins 3 and 4 of J2; the output should be approximately 90 μa. Check 150-cps filter A5Z1 and parts in 150-cps portion of dual-bridge rectifier A5Z3.
Horizontal pointer indicates above or below glide slope when "on glide slope" signal is received.	When an "on glide slope" signal is received and balance control A5R1 is properly adjusted, equal voltage is applied to both the 90- and 150-cps filters. With equal voltage applied to each filter, the horizontal pointer will center. If A5R1 is misadjusted, more voltage will be applied to one filter than to the other, causing this trouble.	Readjust balance control A5R1 as outlined in paragraph 5–7.

5–7. ALIGNMENT AND ADJUSTMENT.

General. The following paragraphs describe the alignment and adjustment procedures for the R-31A Receiver. The test equipment required for performing the procedures is listed in Table 5–1. Interconnections between the R-31A and the test equipment necessary to perform the alignment and adjustment procedures are shown in Figures 5–6 through 5–10. Alignment and adjustment points mentioned in the procedures are shown in Figure 5–5.

First Oscillator and Multiplier Alignment. Normally, alignment of the first oscillator should not be necessary; however, if it is definitely determined that realignment is required, proceed as follows:

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Remove the side plates from the preselector to expose the test and alignment points shown in Figure 5–5. Interconnect the R-31A, C-69A Control Unit, and test equipment as shown in Figure 5–6.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Set up the Boonton Radio Model 232-A Glide Slope Signal Generator. Set the R-31A and the output of the signal generator to 332.6 mc. Adjust the output of the signal generator to 700 μv at the left 2.0 position (90-cps modulation predominant).

Step 3. Connect the Hewlett-Packard Model 410B vtvm between A1TP2 and chassis ground. Adjust A1L5 to obtain maximum negative indication on the voltmeter.

Step 4. Connect the voltmeter between A1TP1 and chassis ground. Adjust A1L7 to obtain maximum negative indication on the voltmeter.

Step 5. With the voltmeter connected as in Step 4, adjust A1L8 to obtain maximum negative indication on the voltmeter.

Second Oscillator Alignment. Align the second oscillator as follows:

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Interconnect the R-31A, C-69A Control Unit, and test equipment as shown in Figure 5–6.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Set up the Boonton Radio Model 232-A Glide Slope Signal Generator. Set the R-31A and the output of the signal generator to 332.0 mc. Adjust the output of the signal generator to

700 μv with the DB TONE RATIO switch at the left 2.0 position (90-cps modulation predominant).

Step 3. Rotate the R-31A sensitivity control, A4R1, fully counterclockwise.

Step 4. Adjust A2Z3 to obtain maximum deviation current on the 150-0-150 microammeter. Reduce the output level of the signal generator as required to maintain less than 50 μa deviation current. After maximum deviation current is obtained, back the coil slug out one-half turn (counterclockwise rotation). This action results in tuning on the inductive side of resonance.

Step 5. Set the R-31A and the signal generator output to 331.7 mc. The microammeter reading should be approximately the same as the reading obtained in Step 4. If necessary, repeat Step 4 to obtain the correct result.

Step 6. If necessary, readjust the sensitivity control.

Centering Adjustment. Center the deviation indicator horizontal pointer as follows:

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Interconnect the R-31A, C-69A Control Unit, and the test equipment as shown in Figure 5–6.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Set up the Boonton Radio Model 232-A Glide Slope Signal Generator. Set the R-31A and the output of the signal generator to 332.0 mc. Adjust the output of the signal generator to 200 μv with the DB TONE RATIO switch at the 0 position (equal amounts of 90- and 150-cps modulation).

Step 3. Adjust balance control A5R1 to obtain zero microamperes on the 150-0-150 microammeter.

Step 4. Check setting of sensitivity control. Recheck balance control.

Sensitivity Adjustment. Adjust the over-all receiver sensitivity as follows:

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Interconnect the R-31A, C-69A Control Unit, and the test equipment as shown in Figure 5–6.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Set up the Boonton Radio Model 232-A Glide Slope Signal Generator. Set the R-31A and the output of the signal generator to 332.0 mc. Adjust the output of the signal generator to 700 μv with the DB TONE RATIO switch at the left 2.0 position (90-cps modulation predominant).

Step 3. Adjust the horizontal pointer centering as outlined in the *Centering Adjustment* procedure.

Step 4. Adjust the sensitivity control, A4R1, to obtain 78 μa deflection current on the 150-0-150 microammeter.

Horizontal Pointer Flag Sensitivity Adustment. Adjust the horizontal pointer flag sensitivity as follows:

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Interconnect the R-31A, C-69A Control Unit, and the test equipment as shown in Figure 5–6.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Set up the Boonton Radio Model 232-A Glide Slope Signal Generator. Set the R-31A and the output of the signal generator to 332.0 mc. Set the output level to 40 μv with the DB TONE RATIO switch at the left 2.0 position (90-cps modulation predominant).

Step 3. Adjust the flag sensitivity control, A5R2, to obtain 350 μa flag current on the 0-1 milliammeter.

Step 4. Set the signal generator output level to 700 μv. The flag current should be at least 270 μa. If necessary, readjust A5R2 to obtain the correct result.

First I-f Alignment with Sweep Generator. If a Jerrold Model 900 Sweep Generator, or equivalent, is available, align the first i-f stages as follows:

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Remove the side plates from the preselector to expose the test and alignment points shown in Figure 5–5. Interconnect the R-31A, C-69A Control Unit, and the test equipment as shown in Figure 5–7.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Let the R-31A and test equipment warm up for five minutes before proceeding.

Step 3. Adjust the Measurements Corp. Model 65-B Signal Generator and the Jerrold Model 900 Sweep Generator for an output of 29.850 mc. Turn on the sweep generator detector amplifier. Adjust the output of the signal generator and the marker amplifier output of the sweep generator to permit observation of the marker signal on the oscilloscope.

Step 4. Adjust slugs of coils on A2Z2 to obtain a symmetrical pattern centered on 29.850 mc as indicated in Figure 5–7.

Note

Avoid overloading the circuits being aligned or the sweep generator detector amplifier. Adjust the sweep generator A.G.C. knob and the Hewlett-Packard attenuators for the lowest output that results in a usable pattern on the oscilloscope.

Step 5. Disconnect the signal generator, the sweep generator, the attenuators, the 47-ohm resistor, and the .01-μf capacitor. Connect the bench test setup as shown in Figure 5–8.

Step 6. Set the C-69A channel-selector switch to 332.0 mc. Set the glide-slope signal generator and the sweep generator to 332.0 mc. Adjust the bandwidth of the sweep generator to obtain a usable marker on the oscilloscope.

Step 7. Switch the glide-slope signal generator between 332.0 and 331.7 mc and observe the markers at both frequencies. Adjust A1L4 and A2Z1 to obtain the waveshape indicated in Figure 5–8.

Note

If the second oscillator signal is visible on the oscilloscope and disrupts the over-all first i-f amplifier pattern, immobilize the second oscillator by shorting the collector of A2Q1 to ground.

R-f Amplifier Alignment with Sweep Generator. If a Jerrold Model 900 Sweep Generator, or equivalent, is available, align the r-f amplifier as follows:

Step 1. Set up the Jerrold Model 900 Sweep Generator, the Boonton Radio Model 232-A Glide Slope Signal Generator, and the Tektronix Model 545 Oscilloscope. Remove the power supply and main chassis dust covers from the R-31A Receiver and interconnect the R-31A, C-69A Control Unit, and the test equipment as shown in Figure 5–8. Keep the leads to the R-31A as short as possible.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Let the R-31A and test equipment warm up for five minutes before proceeding.

Step 3. Turn on the sweep generator detector amplifier. Advance the sweep generator agc control slightly clockwise from the counterclockwise stop.

Note

To initially locate the sweep pattern on the oscilloscope, place the adjustable attenuators in the 0 attenuation position. After the sweep pattern is located, employ the maximum attenuation which still allows a useful pattern on the oscilloscope. No less than 10 db attenuation should be used during r-f alignment.

Step 4. Tune the sweep generator to 332.0 mc. Adjust the marker amplifier control of the sweep generator and the glide-slope signal generator output to a sufficient level to permit observation of the markers on the oscilloscope. The glide-slope signal generator is used as a marker generator, therefore modulation is not necessary.

Step 5. Adjust the bandwidth of the sweep generator so the 329.3 and 335.0 markers are both alternately visible on the oscilloscope.

Step 6. Adjust the brass slugs of coils A1L1, A1L2, and A1L3 so that the tops of the slugs are flush with the surface of the preselector chassis. Tune A1L2 and A1L3 for the best response curve, similar to that shown in Figure 5–8. To check the frequency of the response curve, set the glide-slope signal generator alternately to 329.3 and 335.0 mc.

Step 7. After A1L2 and A1L3 have been adjusted, adjust A1L1 to improve the center frequency (332.0 mc) response.

Adjustment of A1C5 and A1C8. If A1C5 or A1C8 has been replaced, perform the following adjustment procedure.

Step 1. Set up the Jerrold Model 900 Sweep Generator, the Boonton Radio Model 232-A Glide Slope Signal Generator, and the Tektronix Model 545 Oscilloscope. Remove the power supply and main chassis dust covers from the R-31A Receiver and interconnect the R-31A, C-69A Control Unit, and the test equipment as shown in Figure 5–8. Keep the leads to the R-31A as short as possible.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Let the R-31A and test equipment warm up for five minutes before proceeding.

Step 3. Turn on the sweep generator detector amplifier. Advance the sweep generator agc control slightly clockwise from the counterclockwise stop.

Note

To initially locate the sweep pattern on the oscilloscope, place the adjustable attenuators in the 0 attenuation position. After the sweep pattern is located, employ the maximum attenuation which still allows a useful pattern on the oscilloscope. No less than 10 db attenuation should be used during r-f alignment.

Step 4. Tune the sweep generator to 332.0 mc. Adjust the marker amplifier control of the sweep generator and the glide-slope signal generator output to a sufficient level to permit observation of the markers on the oscilloscope. The glide-slope signal generator is used as a marker generator, therefore modulation is not necessary.

Step 5. Adjust the bandwidth of the sweep generator so the 329.3 and 335.0 markers are both alternately visible on the oscilloscope.

Step 6. Adjust the brass slugs of A1L1, A1L2, and A1L3 so that the tops of the slugs are flush with the top of the preselector chassis. Manually position A1C5 and A1C8 for the best response curve, similar to that shown in Figure 5–8. Tune A1L2 and A1L3 to improve the shape of the response curve. To check the frequency range of the curve, set the glide-slope signal generator alternately to 329.3 and 335.0 mc.

Step 7. After A1L2 and A1L3 have been adjusted, adjust A1L1 to improve the center frequency (332.0 mc) response.

First I-f Alignment without Sweep Generator. The recommended method of aligning the first i-f stages is with the use of a Jerrold Model 900 Sweep Generator, or equivalent. However, when a sweep generator is not available, the alternative alignment procedure outlined below may be used.

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Interconnect the R-31A, C-69A Control Unit, and test equipment as shown in Figure 5–9. Keep the leads to the R-31A as short as possible.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Let the R-31A and test equipment warm up for five minutes before proceeding.

Step 3. Set the output of the signal generator to 29.85 mc. Modulate this carrier with 40%, 1000-cps audio.

Step 4. Back the primary slug of A2Z2 to the full counterclockwise position. (The primary slug is the one closest to A2Z1.) Adjust the secondary slug of A2Z2 to obtain a maximum reading on the vtvm. Adjust the primary slug of A2Z2 to obtain a maximum reading on the vtvm.

Note

After the primary slug of A2Z2 is adjusted, do not readjust the secondary slug.

Step 5. Remove the .01-μf capacitor and the 47-ohm resistor from pin 1 of A2V1. Connect the capacitor and resistor to pin 5 of A1V2. Apply the output of the signal generator to the free end of the capacitor. Connect the negative terminal of the 3-volt bias battery to the tube agc bus.

Step 6. Adjust the slug of A2Z1 to obtain a maximum reading on the vtvm. Do not attempt to readjust the slugs of A2Z2.

Step 7. Remove the capacitor and resistor from pin 5 of A1V2 and reconnect them to pin 1 of A1V2. Connect the signal generator to the free end of the capacitor. Adjust A1L4 to obtain a maximum reading on the vtvm. Do not attempt readjustment of A2Z1 or A2Z2 slugs.

R-f Amplifier Alignment without Sweep Generator. The recommended method of aligning the r-f stages is with the use of a Jerrold Model 900 Sweep Generator, or equivalent. However, when a sweep generator is not available, the alternative alignment procedure outlined below may be used.

Note

Do not attempt alignment of the r-f amplifier unless the i-f stages have been aligned previously.

Step 1. Remove the power supply and main chassis dust covers from the R-31A Receiver. Interconnect the R-31A, C-69A Control Unit, and test equipment as shown in Figure 5–10. Keep the leads to the R-31A as short as possible.

Step 2. Turn on the primary power source and adjust the supply voltage to 13.75 volts dc (for 14-volt model) or 27.5 volts dc (for 28-volt model). Set the C-69A REC-OFF switch to REC. Let the R-31A and test equipment warm up for five minutes before proceeding.

Step 3. Set up the Boonton Radio Model 232-A Glide Slope Signal Generator. Adjust the output frequency to 331.7 mc. Set the C-69A channel-selector switch to 331.7 mc.

Step 4. Adjust the slug of A1L2 to obtain maximum deflection current on the 150-0-150 microammeter. Reduce the r-f output of the signal generator so that the deflection current does not exceed 50 μa.

Step 5. Adjust the slug of A1L1 to obtain maximum deflection current. Do not attempt to repeak A1L2. As the slug of A1L1 is adjusted, a broad resonance will be achieved. This resonance will be indicated by a slight change in deflection current.

Note

Since A1L1 contributes little to the over-all bandpass of the r-f tuned circuits, a compromise between slug position and maximum meter deflection is permissible.

Step 6. Remove the 47-ohm resistor previously connected between pins 1 and 8 of A1V2. Adjust the brass slug of A1L3 to obtain maximum deflection current. Do not readjust A1L1 or A1L2.

Step 7. Set the R-31A and the signal generator alternately to 329.3 and 335.0 mc. Readjust A1L2 only to obtain equal deflection current at each of these frequencies. Do not readjust A1L1 or A1L3.

5–8. MEASUREMENTS.

Typical voltage and resistance measurements for the R-31A Receiver are shown in Figures 5–11 and 5–12. Typical stage gain measurements are listed in Table 5–5. The measurements were made under the conditions noted.

5–9. CONTROL UNIT MAINTENANCE.

General. Either the C-69A Control Unit, the C-88A Control Unit, or the CC-12A Custom Control Unit may be used to control the R-31A Receiver. Maintenance for all three control units consists of visual inspection of internal connections, visual inspection of the connector pin plugs, and replacement of panel lamps. When a C-88A or CC-12A is used, lubrication of the channel-selector switch is also necessary (refer to paragraph 5–4). With the exception of the channel-selector switch used in the C-88A or CC-12A, all parts may be replaced in the field. If the channel-selector switch becomes defective, replace the control unit and return the defective unit to the factory for servicing.

Caution

Excessive soldering iron heat applied to the terminals on the printed circuit plates of the channel-selector switch assembly will affect the position and pressure of the contact springs.

TABLE 5–5. R-31A RECEIVER STAGE GAIN MEASUREMENTS

Conditions:

1. With the exception of the Model 232-A, all equipment connected as shown in Figure 5–6.
2. Test conditions described in paragraph 5–5 apply.
3. C-69A channel-selector switch set to 332.0 mc.
4. Boonton Radio Model 232-A Glide Slope Signal Generator used for input frequency of 332.0 mc. Measurements Corp. Model 65-B Signal Generator used for all other input frequencies.
5. Tektronix Model 545 Oscilloscope used for peak-to-peak output measurements. All other output measurements taken with a 150-0-150 microammeter connected as shown.
6. Signal input not to exceed level which causes tube agc to take hold.
7. Except as noted, all inputs modulated with 90 cps at 30%.

Input			Output		DB Gain From Previous Signal Injection Point
Signal Injection Point	Voltage	Frequency	Monitoring Point	Magnitude	
Antenna Jack	8 μv	332.0 mc	J2 (pin 3 to 4)	90 μa	—
A1V1 (pin 1)	14 μv	332.0 mc	J2 (pin 3 to 4)	90 μa	5
A1V2 (pin 1)	150 μv	332.0 mc	J2 (pin 3 to 4)	90 μa	19
A2V1 (pin 1)	340 μv	30.0 mc	J2 (pin 3 to 4)	90 μa	8
A2Q2 (emitter)	860 μv	30.0 mc	J2 (pin 3 to 4)	90 μa	8
A3Q1 (base)	3.7K μv	1.7 mc	J2 (pin 3 to 4)	90 μa	13
A3Q2 (base)	3.3K μv	1.7 mc	J2 (pin 3 to 4)	90 μa	–1
A3Q3 (base)	25K μv	1.7 mc	J2 (pin 3 to 4)	90 μa	18
A3Q4 (emitter)	40K μv	1.7 mc	J2 (pin 3 to 4)	90 μa	4
A3Q4 (collector)	1040K μv	1.7 mc	J2 (pin 3 to 4)	90 μa	28
A4Q3 (base)	140K μv	1.7 mc	J2 (pin 3 to 4)	90 μa	
Antenna Jack	[1]8 μv	332.0 mc	A4Q3 (base)	0.4 V (p-p)	–17
Antenna Jack	8 μv	332.0 mc	A4Q3 (base)	0.7 V (p-p)	
Antenna Jack	8 μv	332.0 mc	A4Q3 (collector)	0.4 V (p-p)	–5
Antenna Jack	8 μv	332.0 mc	A4Q4 (collector)	1 V (p-p)	8
Antenna Jack	8 μv	332.0 mc	A4Q5 (collector)	1.8 V (p-p)	5
Antenna Jack	8 μv	332.0 mc	A5T1 (pin 4)	22 V (p-p)	22

[1] No modulation.

C-69A or C-88A Panel Lamp Replacement. The C-69A uses either four type 327 (28-volt) or four type 330 (14-volt) flange-base, midget panel lamps (see Figure 6–11). The C-88A uses two of either of these lamps (see Figure 6–13). To replace a lamp in either the C-69A or C-88A, proceed as follows:

Step 1. Unscrew the lamp housing and remove it with the black rubber light shade and lamp.

Step 2. Insert the thin edge of a knife blade, or the fingernails between the flange base of the lamp and the threaded bushing; then withdraw the lamp.

Step 3. Insert a new lamp, seating the flange of the base firmly against the threaded bushing.

Step 4. Replace the lamp housing and screw it back fingertight.

CC-12A Panel Lamp Replacement. The CC-12A uses either two type 327 (28-volt) or two type 330 (14-volt) flange-base, midget panel lamps (see Figure 6–15). To replace a lamp in the CC-12A, proceed as follows:

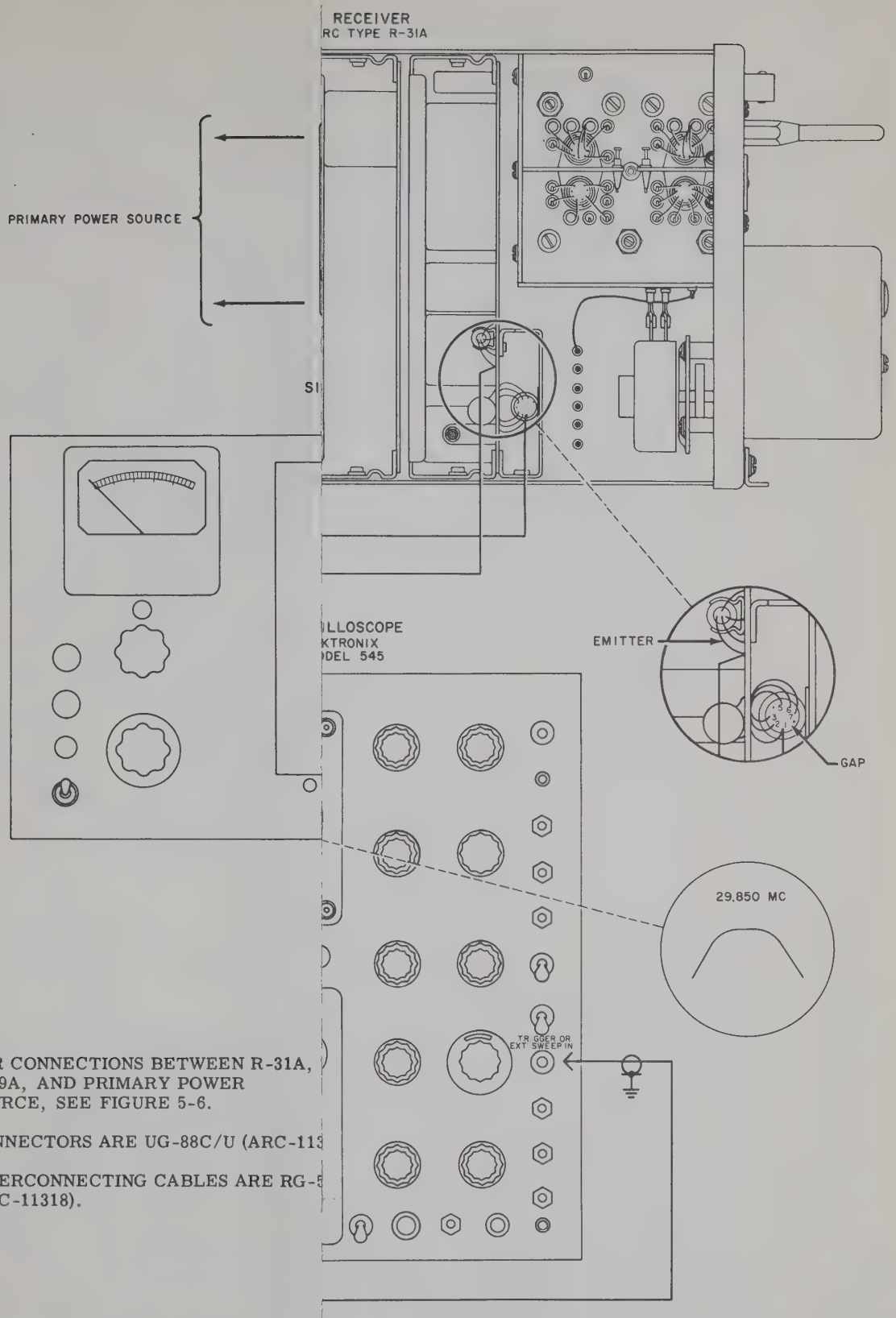
Step 1. Unscrew the cap and spring assembly.

Step 2. Pull the lamp and the black rubber lamp retainer out of the cap and spring assembly.

Step 3. Remove the lamp from the lamp retainer.

Step 4. Place the lamp retainer over the new lamp. Replace the lamp and retainer in the cap and spring assembly.

Step 5. Screw the cap and spring assembly into the light retainer.



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-113
3. INTERCONNECTING CABLES ARE RG-5 (ARC-11318).

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Figure 5–7. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier with Sweep Generator

C-69A or C-88A Panel Lamp Replacement. The C-69A uses either four type 327 (28-volt) or four type 330 (14-volt) flange-base, midget panel lamps (see Figure 6–11). The C-88A uses two of either of these lamps (see Figure 6–13). To replace a lamp in either the C-69A or C-88A, proceed as follows:

Step 1. Unscrew the lamp housing and remove it with the black rubber light shade and lamp.

Step 2. Insert the thin edge of a knife blade, or the fingernails between the flange base of the lamp and the threaded bushing; then withdraw the lamp.

Step 3. Insert a new lamp, seating the flange of the base firmly against the threaded bushing.

Step 4. Replace the lamp housing and screw it back fingertight.

CC-12A Panel Lamp Replacement. The CC-12A uses either two type 327 (28-volt) or two type 330 (14-volt) flange-base, midget panel lamps (see Figure 6–15). To replace a lamp in the CC-12A, proceed as follows:

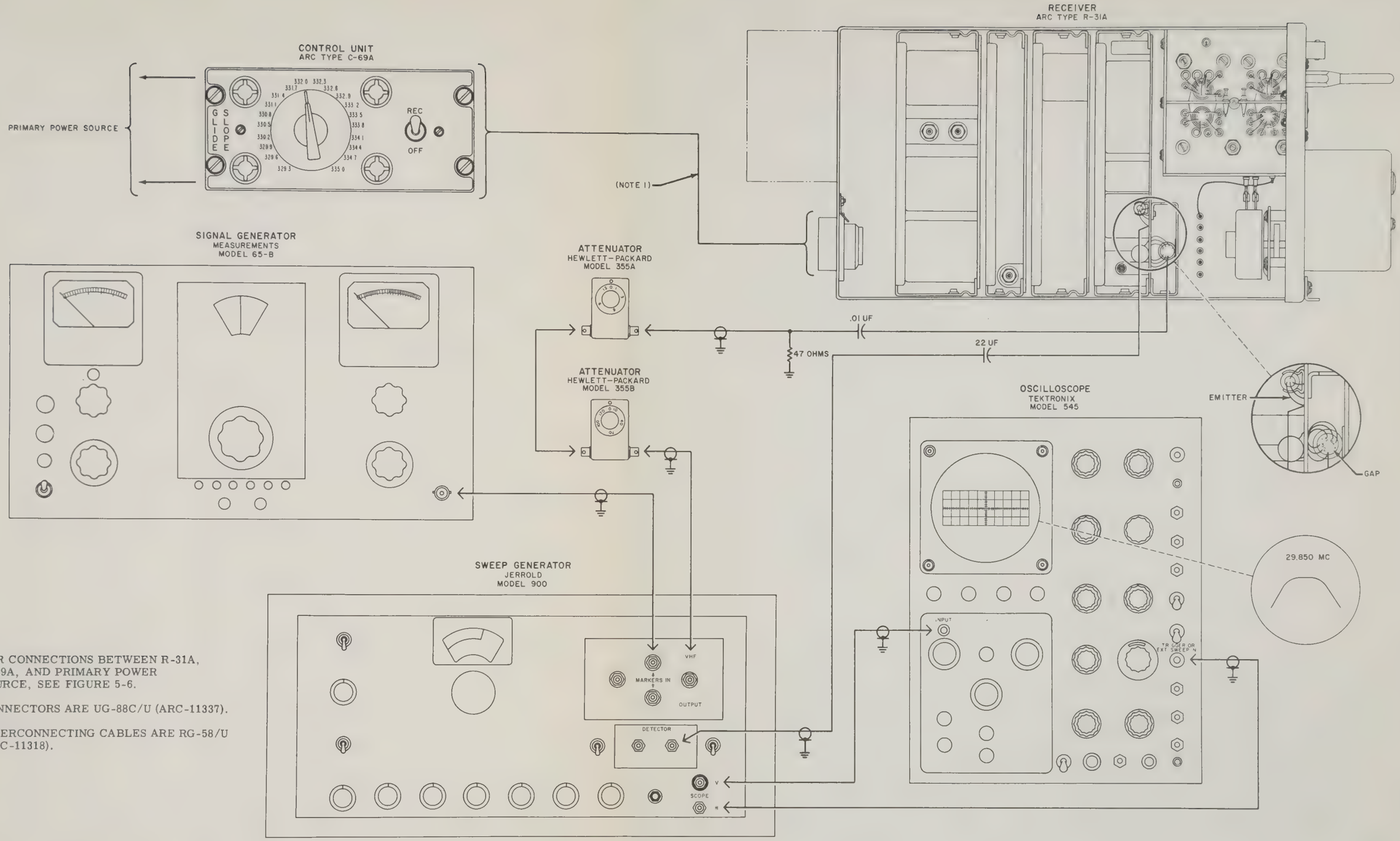
Step 1. Unscrew the cap and spring assembly.

Step 2. Pull the lamp and the black rubber lamp retainer out of the cap and spring assembly.

Step 3. Remove the lamp from the lamp retainer.

Step 4. Place the lamp retainer over the new lamp. Replace the lamp and retainer in the cap and spring assembly.

Step 5. Screw the cap and spring assembly into the light retainer.



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-11337).
3. INTERCONNECTING CABLES ARE RG-58/U (ARC-11318).

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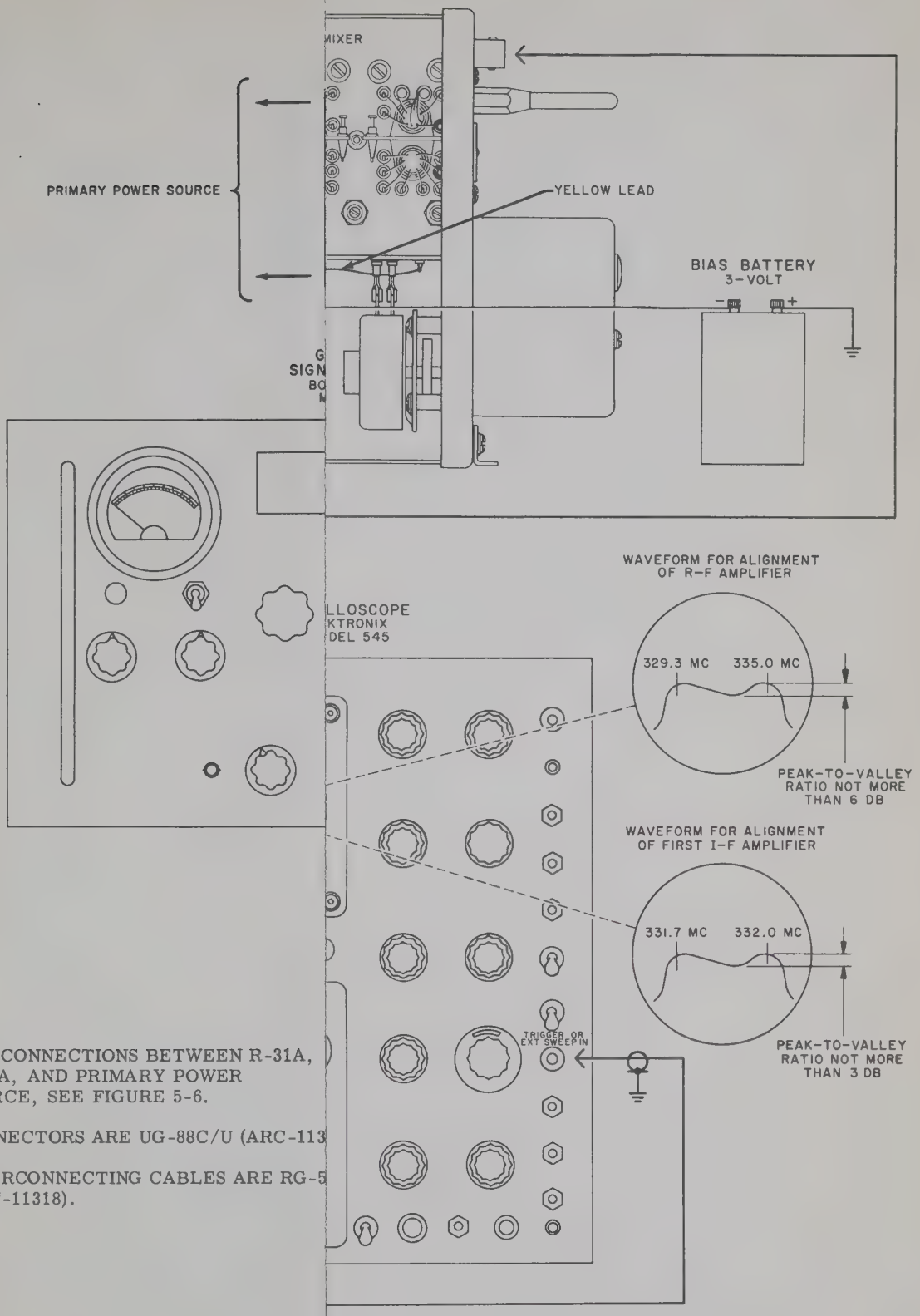
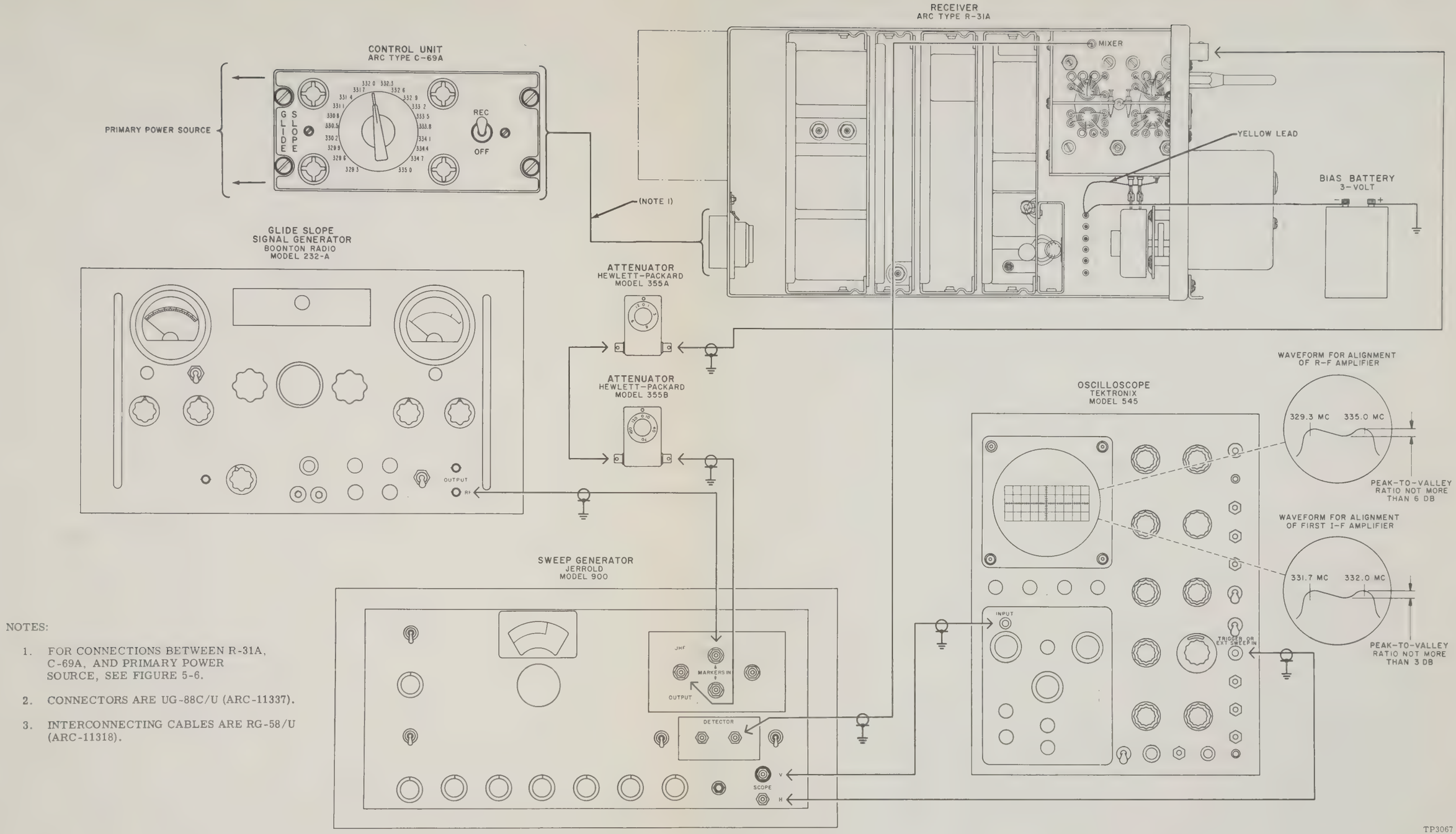
Figure 5–7. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier with Sweep Generator



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-113
3. INTERCONNECTING CABLES ARE RG-5 (ARC-11318).

Figure 5–8. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier and R-f Amplifier with Sweep Generator



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-11337).
3. INTERCONNECTING CABLES ARE RG-58/U (ARC-11318).

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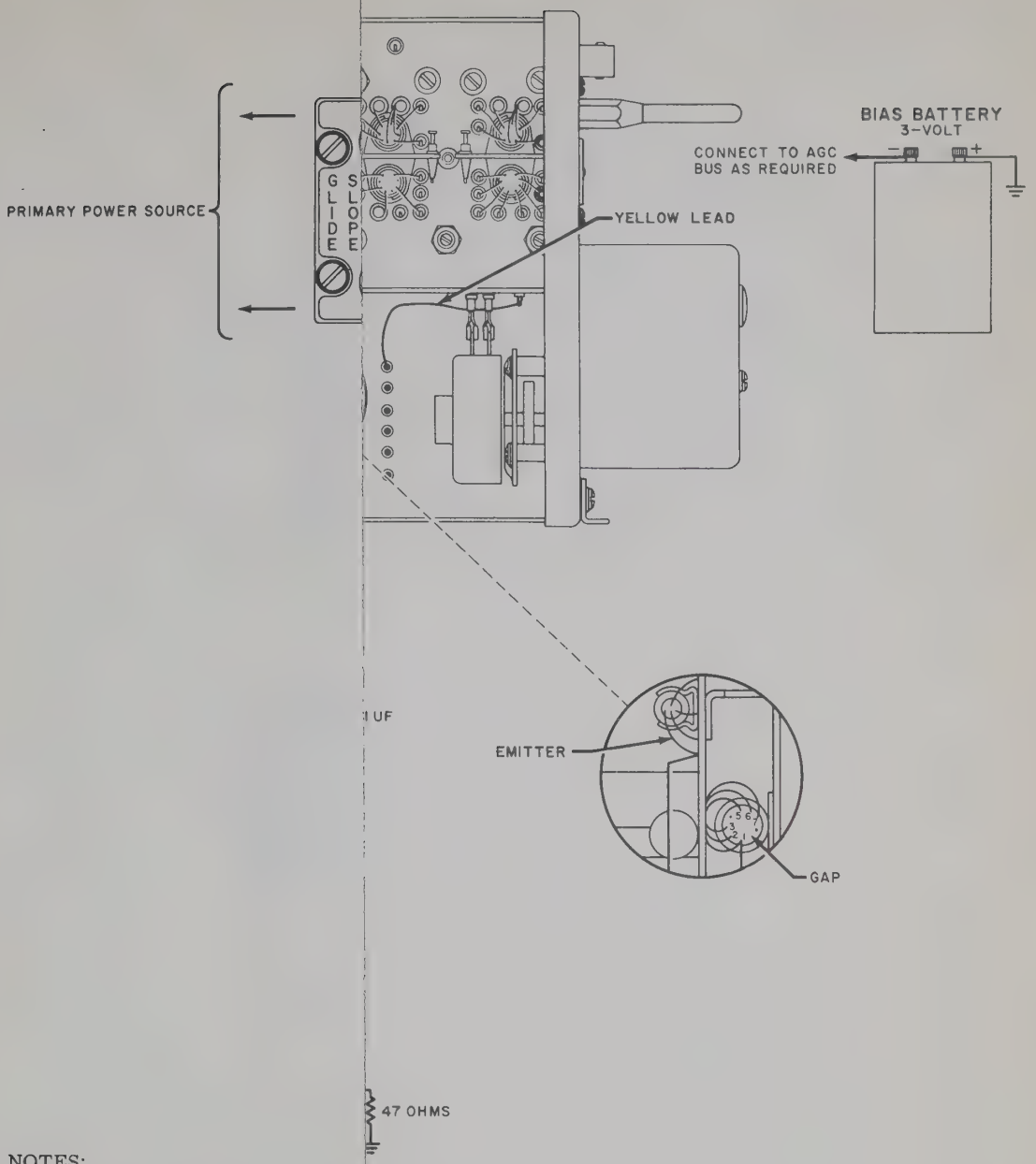
Figure 5–8. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier and R-f Amplifier with Sweep Generator



NOTES:

1. FOR CONNECTIONS BETW
SOURCE, SEE FIGURE 5-6
2. CONNECTORS ARE UG-88C
3. INTERCONNECTING CABL

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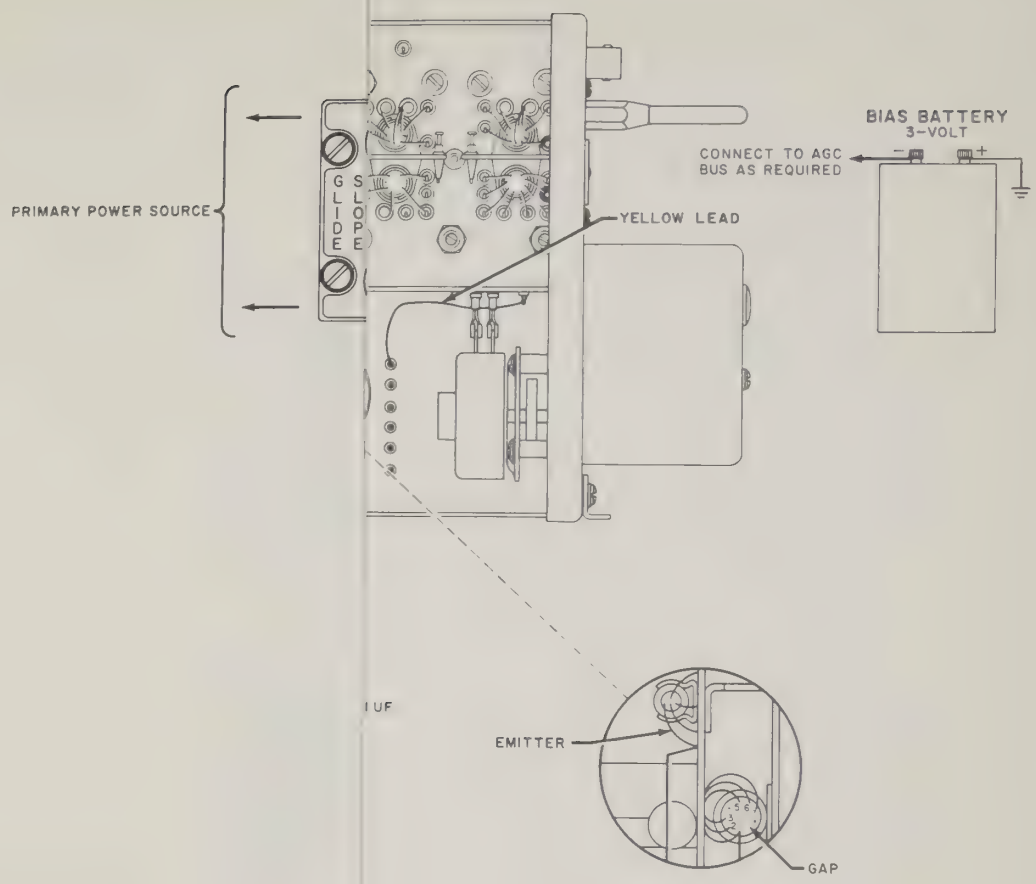
Figure 5–9. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier without Sweep Generator



NOTES:

1. FOR CONNECTIONS BETW
SOURCE, SEE FIGURE 5-6
2. CONNECTORS ARE UG-88C
3. INTERCONNECTING CABL

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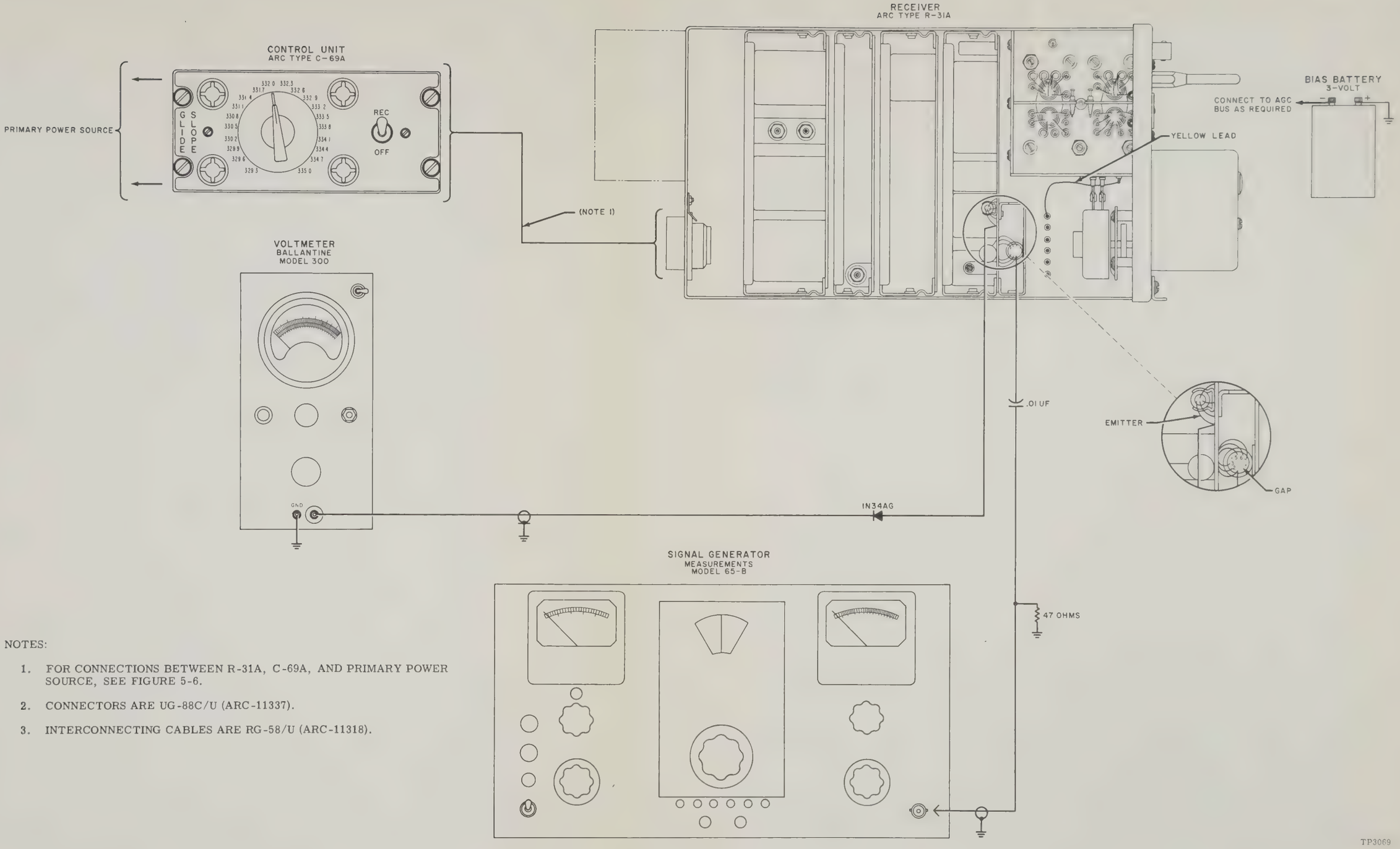
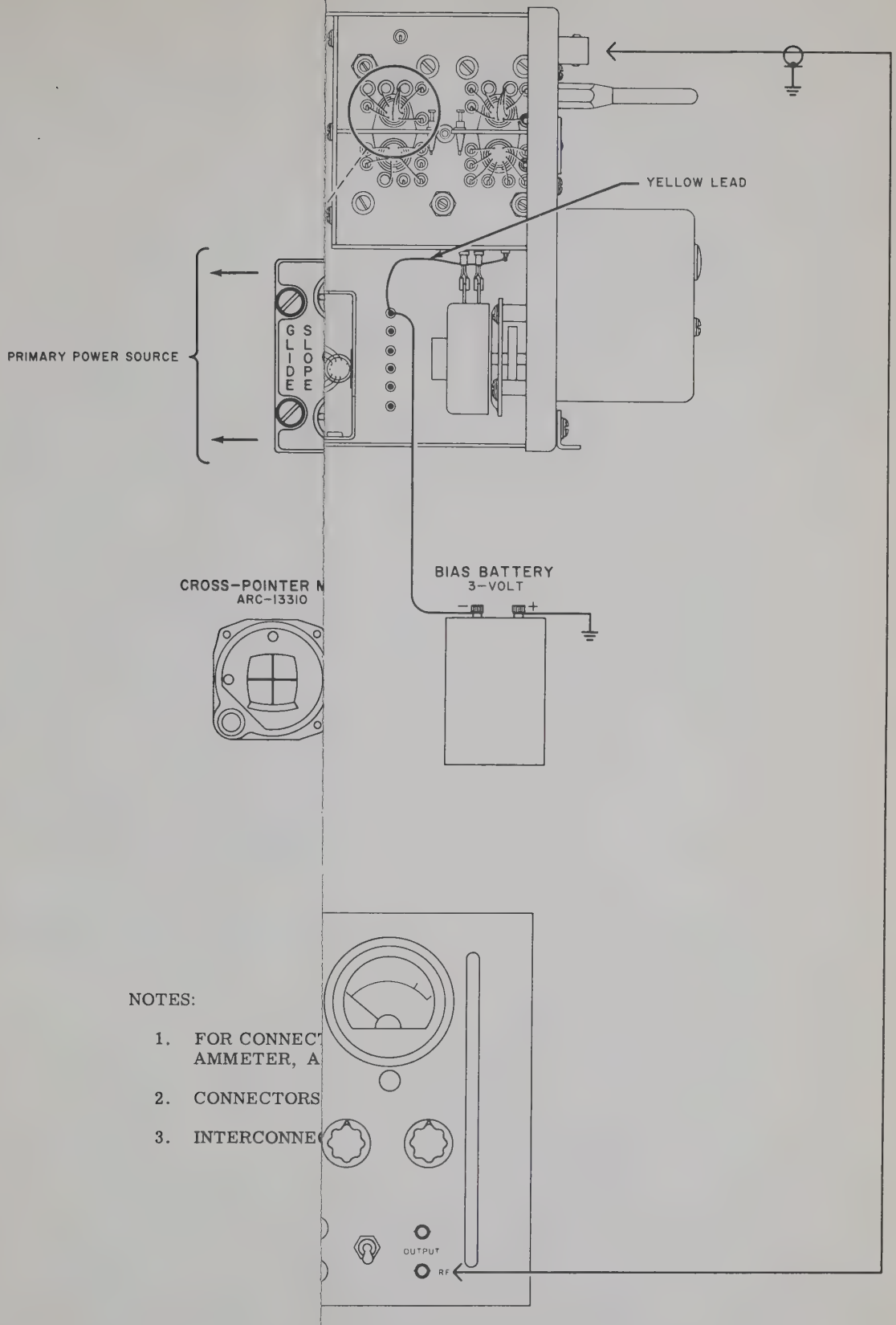
Figure 5–9. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier without Sweep Generator



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-11337).
3. INTERCONNECTING CABLES ARE RG-58/U (ARC-11318).

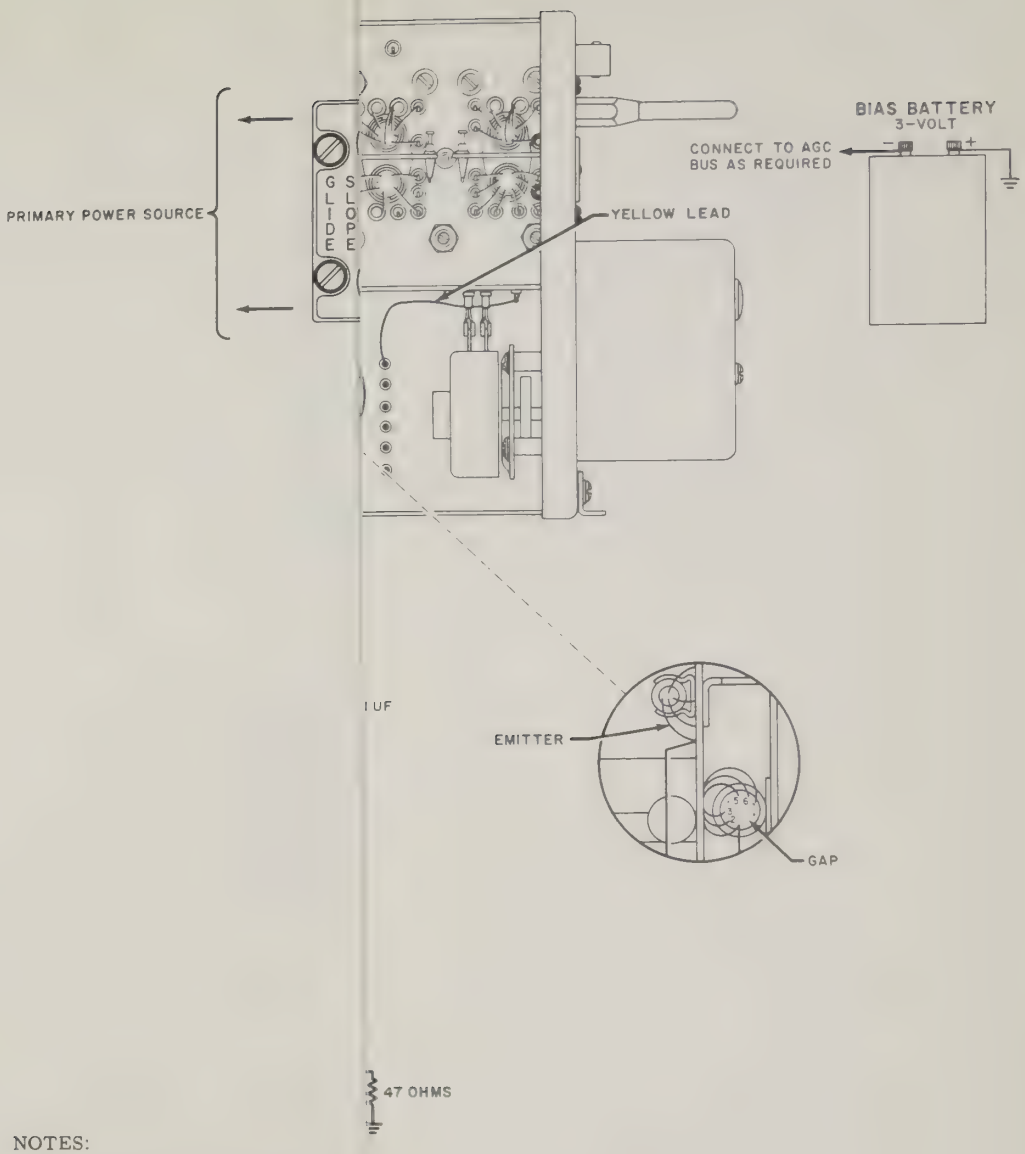
Figure 5–9. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier without Sweep Generator



NOTES:

1. FOR CONNEC
AMMETER, A
2. CONNECTORS
3. INTERCONNE

Figure 5–10. Bench Test Interconnection Diagram for Alignment of R-f Amplifier without Sweep Generator



NOTES:

1. FOR CONNECTIONS BETW
SOURCE, SEE FIGURE 5-6
2. CONNECTORS ARE UG-88C
3. INTERCONNECTING CABL

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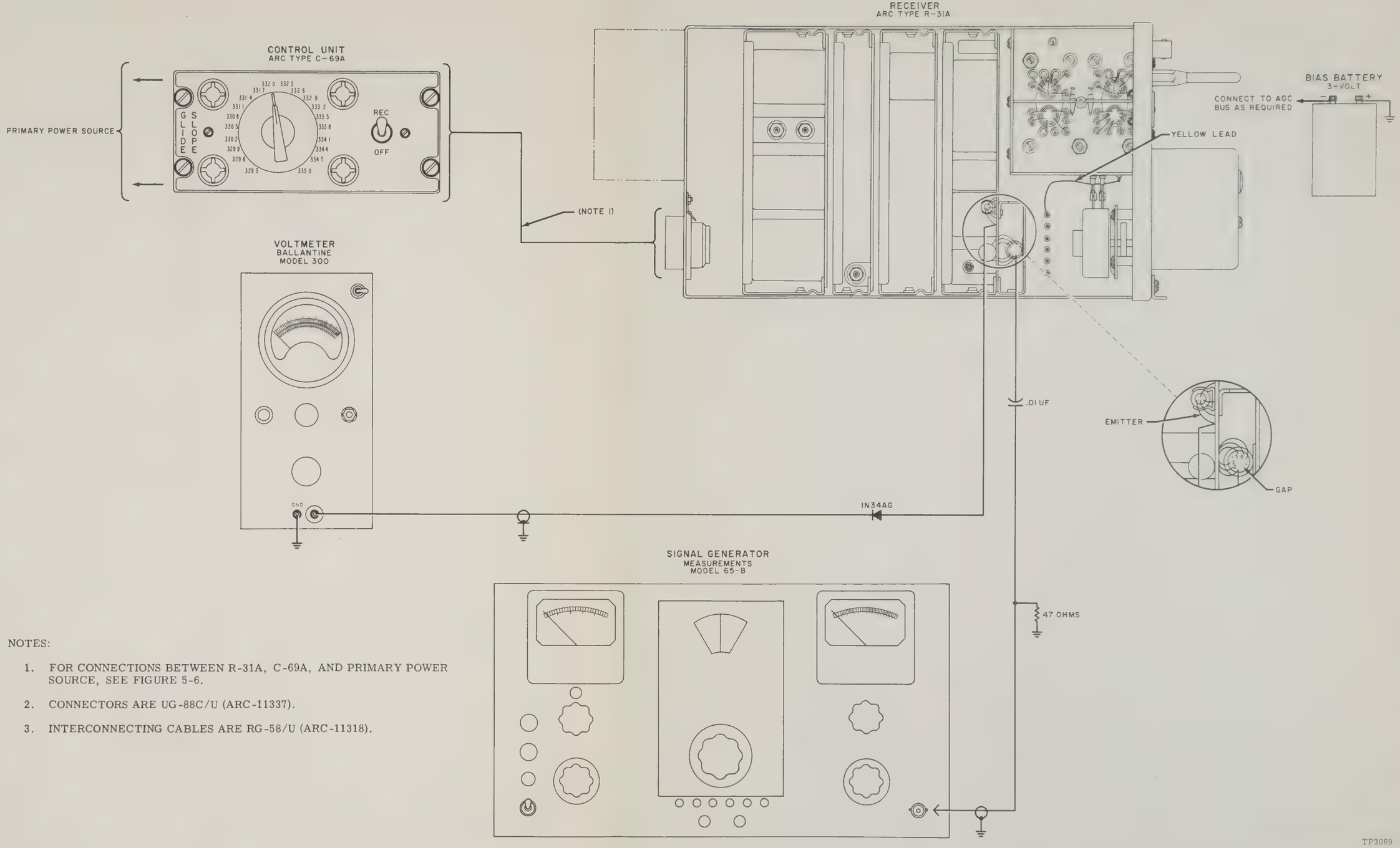
Figure 5–9. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier without Sweep Generator



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-11337).
3. INTERCONNECTING CABLES ARE RG-58/U (ARC-11318).

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Figure 5–9. Bench Test Interconnection Diagram for Alignment of First I-f Amplifier without Sweep Generator

85
>5 MEG

5.5
3.3

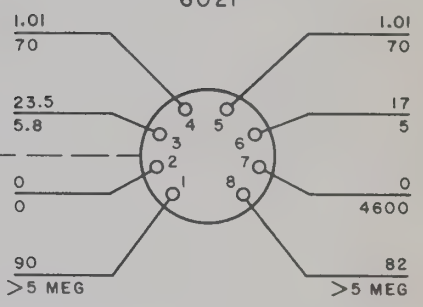
95
>5 MEG

1.3
130

NOTES:

1. VOLTAGES ARE DC AND APPEAR ABOVE
2. RESISTANCES ARE IN OHMS AND APPEAR
   MULTIPLIERS: K=1000, MEG=1,000,000.
3. VOLTAGE VALUES ARE APPROXIMATE A
   CONDITIONS:
   (A) VALUES ARE WITH RESPECT T
   (B) INPUT VOLTAGE SET TO 27.5
   OR 13.75 (FOR 14-VOLT UNIT)
   (C) HEWLETT-PACKARD MODEL 4
   VOLTMETER USED FOR MEAS
   (D) RECEIVER CHANNELED TO 33
   (E) NO R-F SIGNAL INPUT.
4. RESISTANCE VALUES ARE APPROXIMATE
   CONDITIONS:
   (A) INTERCONNECTING CABLES D
   R-31A.
   (B) VALUES ARE WITH RESPECT T
   (C) HEWLETT-PACKARD MODEL 4
   VOLTMETER USED FOR MEAS
5. NC INDICATES NO CONNECTION.
6. READINGS AT TP1 AND TP2 TAKEN WITH

FIRST CRYSTAL OSCILLATOR
AND DOUBLER
AIV3
6021



TRIPLER
AIV4
5718

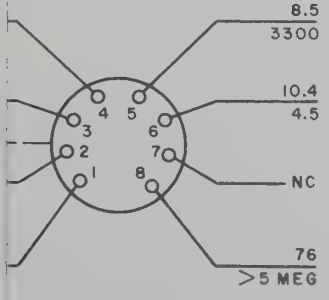


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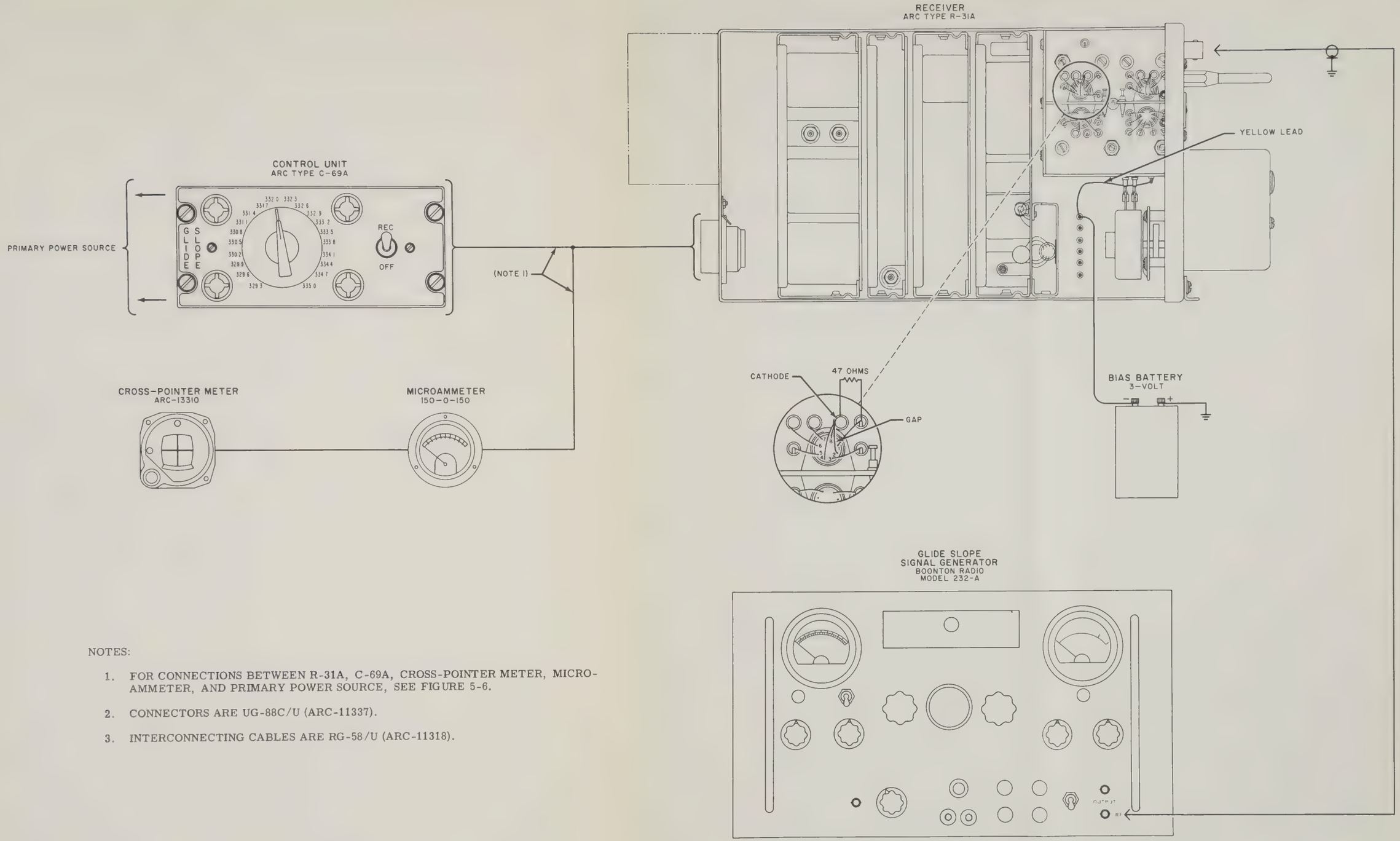
Figure 5–11. R-31A Receiver, Electron Tube Voltage and Resistance Diagram



NOTES:

1. FOR CONNECTIONS BETWEEN R-31A, C-69A, CROSS-POINTER METER, MICRO-AMMETER, AND PRIMARY POWER SOURCE, SEE FIGURE 5-6.
2. CONNECTORS ARE UG-88C/U (ARC-11337).
3. INTERCONNECTING CABLES ARE RG-58/U (ARC-11318).

Figure 5–10. Bench Test Interconnection Diagram for Alignment of R-f Amplifier without Sweep Generator

NOTES:

1. VOLTAGES ARE DC AND APPEAR ABOVE THE REFERENCE LINE.

2. RESISTANCES ARE IN OHMS AND APPEAR BELOW THE REFERENCE LINE. MULTIPLIERS: K=1000, MEG=1,000,000.

3. VOLTAGE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:

   (A) VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   (B) INPUT VOLTAGE SET TO 27.5 (FOR 28-VOLT UNIT) OR 13.75 (FOR 14-VOLT UNIT).
   (C) HEWLETT-PACKARD MODEL 410B VACUUM TUBE VOLTMETER USED FOR MEASUREMENTS.
   (D) RECEIVER CHANNELED TO 332.0 MC.
   (E) NO R-F SIGNAL INPUT.

4. RESISTANCE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:

   (A) INTERCONNECTING CABLES DISCONNECTED FROM R-31A.
   (B) VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   (C) HEWLETT-PACKARD MODEL 410B VACUUM TUBE VOLTMETER USED FOR MEASUREMENTS.

5. NC INDICATES NO CONNECTION.

6. READINGS AT TP1 AND TP2 TAKEN WITH PRESELECTOR ALIGNED AT 332.6 MC.

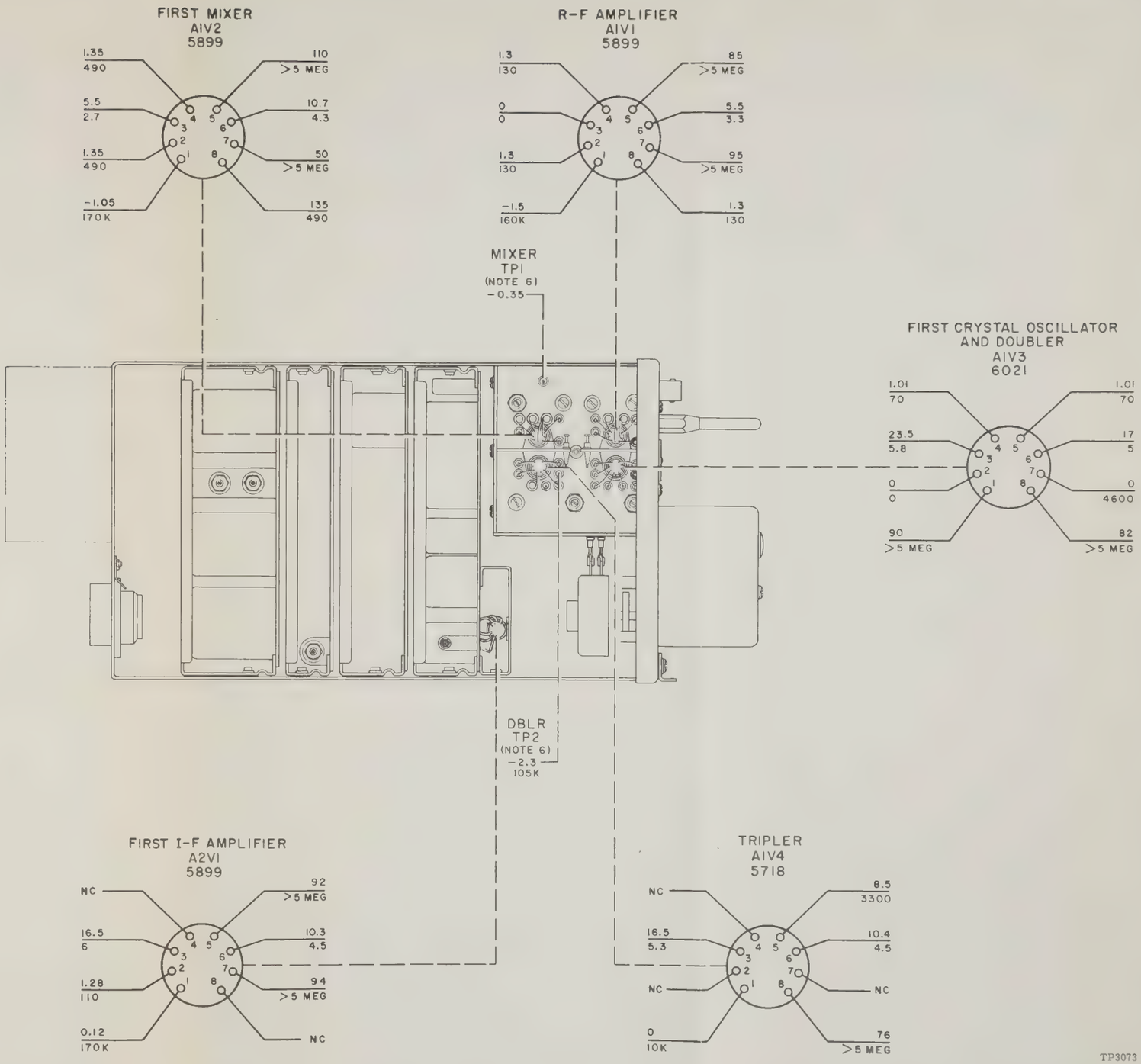


Figure 5–11. R-31A Receiver, Electron Tube Voltage and Resistance Diagram

NOTES:

1. VOLTAGES ARE DC.
2. VOLTAGE VALUES ARE APPROXIMATE AN BASED ON THE FOLLOWING CONDITIONS:
   - (A) VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   - (B) INPUT VOLTAGE SET TO 27.5 (FOR 28-VOLT UNIT) OR 13.75 (FOR 14-VOLT UNIT).
   - (C) HEWLETT-PACKARD MODEL 410B VACUUM TUBE VOLTMETER USED FOR MEASUREMENTS.
   - (D) RECEIVER CHANNELED TO 332.0 MC.
   - (E) NO R-F SIGNAL INPUT.

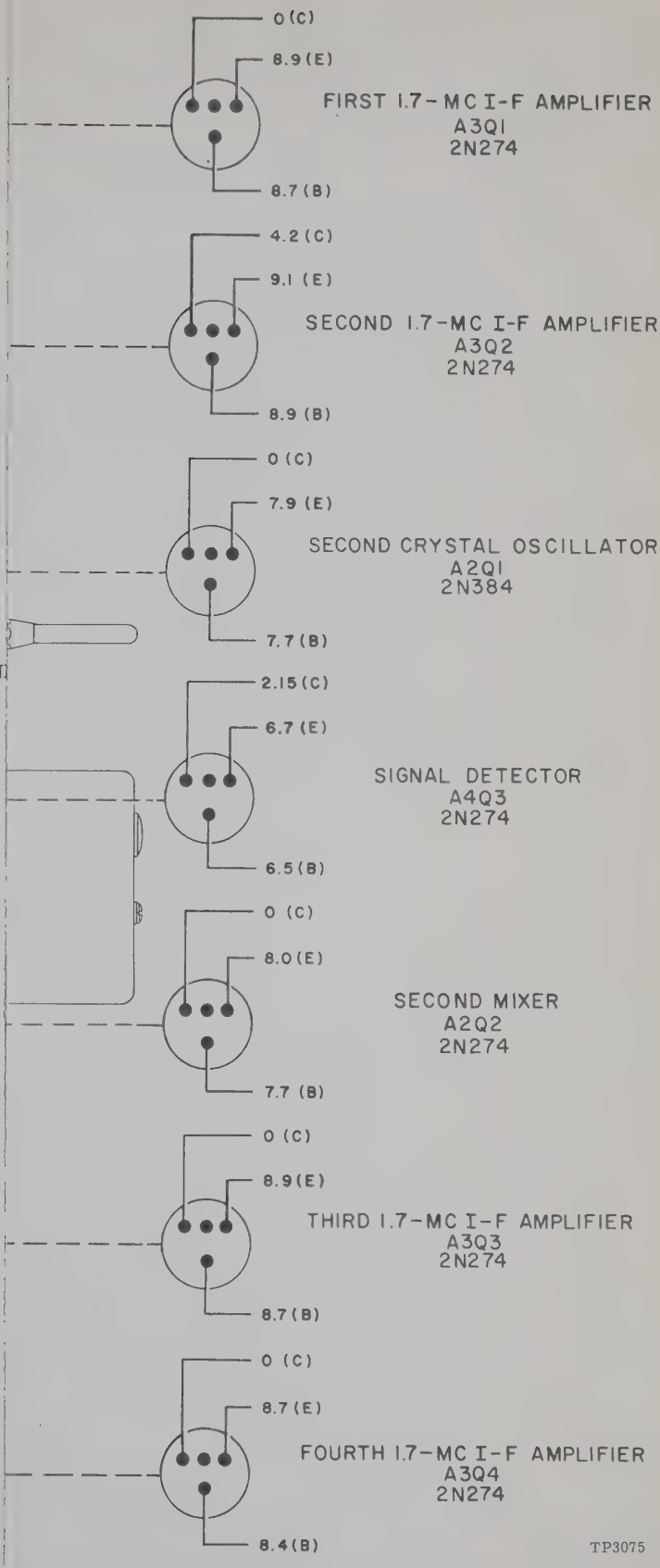
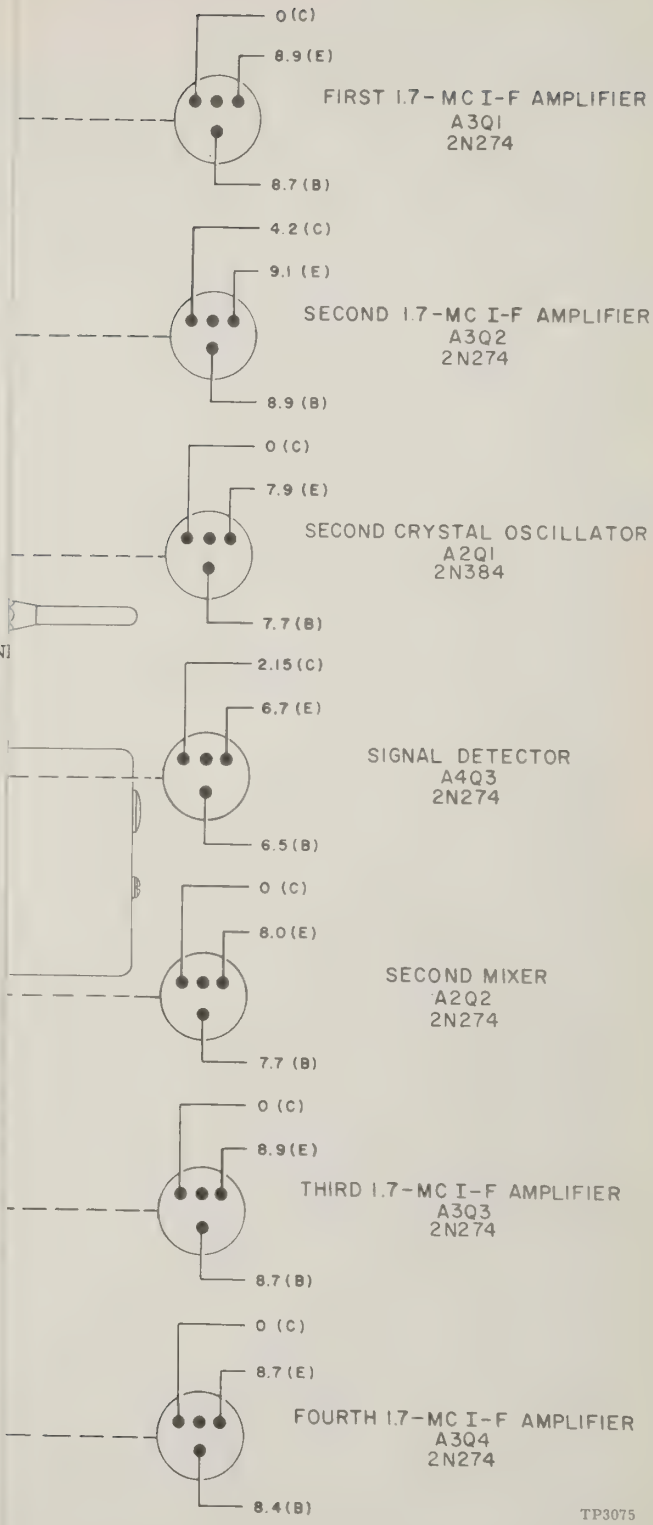


Figure 5–12. R-31A Receiver, Transistor Voltage Diagram



NOTES:

1. VOLTAGES ARE DC.
2. VOLTAGE VALUES ARE APPROXIMATE AN BASED ON THE FOLLOWING CONDITIONS:
   - (A) VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   - (B) INPUT VOLTAGE SET TO 27.5 (FOR 28-VOLT UNIT) OR 13.75 (FOR 14-VOLT UNIT).
   - (C) HEWLETT-PACKARD MODEL 410B VACUUM TUBE VOLTMETER USED FOR MEASUREMENTS.
   - (D) RECEIVER CHANNELED TO 332.0 MC.
   - (E) NO R-F SIGNAL INPUT.

Figure 5–12. R-31A Receiver, Transistor Voltage Diagram

NOTES:

1. VOLTAGES ARE DC.
2. VOLTAGE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   - (A) VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   - (B) INPUT VOLTAGE SET TO 27.5 (FOR 28-VOLT UNIT) OR 13.75 (FOR 14-VOLT UNIT).
   - (C) HEWLETT-PACKARD MODEL 410B VACUUM TUBE VOLTMETER USED FOR MEASUREMENTS.
   - (D) RECEIVER CHANNELED TO 332.0 MC.
   - (E) NO R-F SIGNAL INPUT.

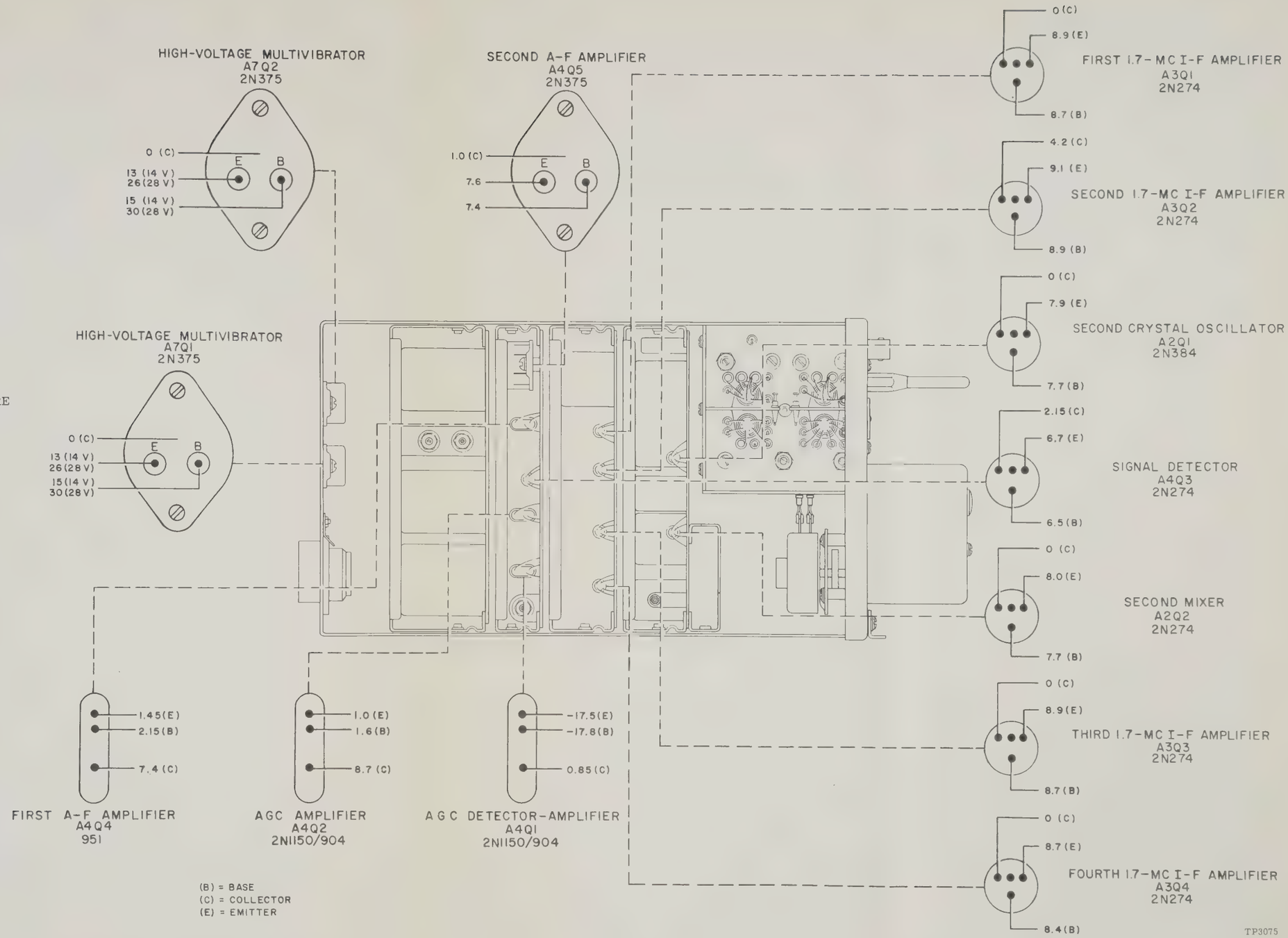


Figure 5–12. R-31A Receiver, Transistor Voltage Diagram

SECTION VI

DIAGRAMS

Figure 6–1. R-31A Receiver, Schematic Diagram

Figure 6–2. Main Assembly A8, Wiring Diagram

Figure 6–3. Preselector Assembly A1, Wiring Diagram

Figure 6–4. First I-f Assembly A2, Wiring Diagram

Figure 6–5. Second I-f Assembly A3, Wiring Diagram

Figure 6–6. Af-Agc Assembly A4, Wiring Diagram

Figure 6–7. Meter Assembly A5, Wiring Diagram

Figure 6–8. Channel Selector A6, Wiring Diagram

Figure 6–9. Power Supply Assembly A7, Wiring Diagram

Figure 6–10. C-69A Control Unit, Schematic Diagram

Figure 6–11. C-69A Control Unit, Wiring Diagram

Figure 6–12. C-88A Control Unit, Schematic Diagram

Figure 6–13. C-88A Control Unit, Wiring Diagram

Figure 6–14. CC-12A Custom Control Unit, Schematic Diagram

Figure 6–15. CC-12A Custom Control Unit, Wiring Diagram

ARC-V-314 S/S mod

1 ea 2p2T 4p Switch #

1 ea JBT-MS-3a-2 2pTDT switch

1 ea 22443 connector assembly (ARC)

1 ea 1K ½w resistor

1 ea 3 pin power plug

4 ea banana jacks

NOTES:

1. REFERENCE DESIGNATIONS ARE ABBRI
PLETE IDENTIFICATION, PREFIX THE
WITH THE ASSEMBLY DESIGNATION A1,
AMPLE, A1C1.

2. FOR RECEIVER WIRING DIAGRAM, SEE
SOCIATED WIRING DIAGRAMS ARE AS F

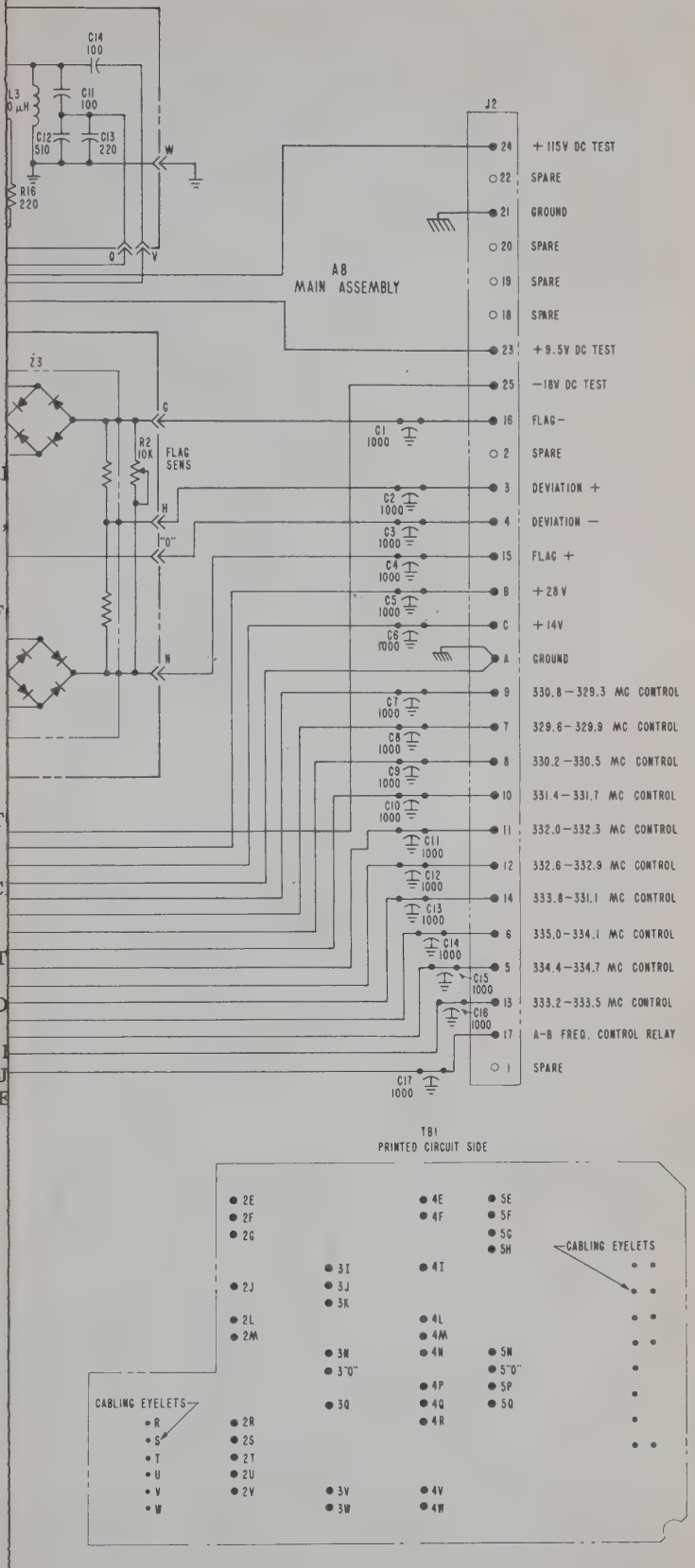
ASSEMBLY DESIG	ASSEMBLY
A1	PRESELECTOR
A2	FIRST I-F
A3	SECOND I-F
A4	AF/AGC
A5	METER
A6	CHANNEL SELECT
A7	POWER SUPPLY

3. CAPACITOR VALUES ARE IN MICROMIC
UNLESS OTHERWISE NOTED.

4. RESISTOR VALUES ARE IN OHMS; MULT

5. RELAYS ARE IN DEENERGIZED POSITIO

6. VALUES OF A4R12 AND A4R18 ARE SELI
STALLED DURING FINAL FACTORY ADJ
VALUES SPECIFIED ARE APPROXIMATE



21422D(TP)

Figure 6–1. R-31A Receiver, Schematic Diagram

NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION A1, A2, ETC; FOR EXAMPLE, A1C1.

2. FOR RECEIVER WIRING DIAGRAM, SEE FIGURE 6-2. ASSOCIATED WIRING DIAGRAMS ARE AS FOLLOWS:

ASSEMBLY DESIG	ASSEMBLY	FIGURE NO.
A1	PRESELECTOR	6-3
A2	FIRST I-F	6-4
A3	SECOND I-F	6-5
A4	AF/AGC	6-6
A5	METER	6-7
A6	CHANNEL SELECTOR	6-8
A7	POWER SUPPLY	6-9

3. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F), UNLESS OTHERWISE NOTED.

4. RESISTOR VALUES ARE IN OHMS; MULTIPLIER: K=1000.

5. RELAYS ARE IN DEENERGIZED POSITION.

6. VALUES OF A4R12 AND A4R18 ARE SELECTED AND INSTALLED DURING FINAL FACTORY ADJUSTMENT. VALUES SPECIFIED ARE APPROXIMATE.

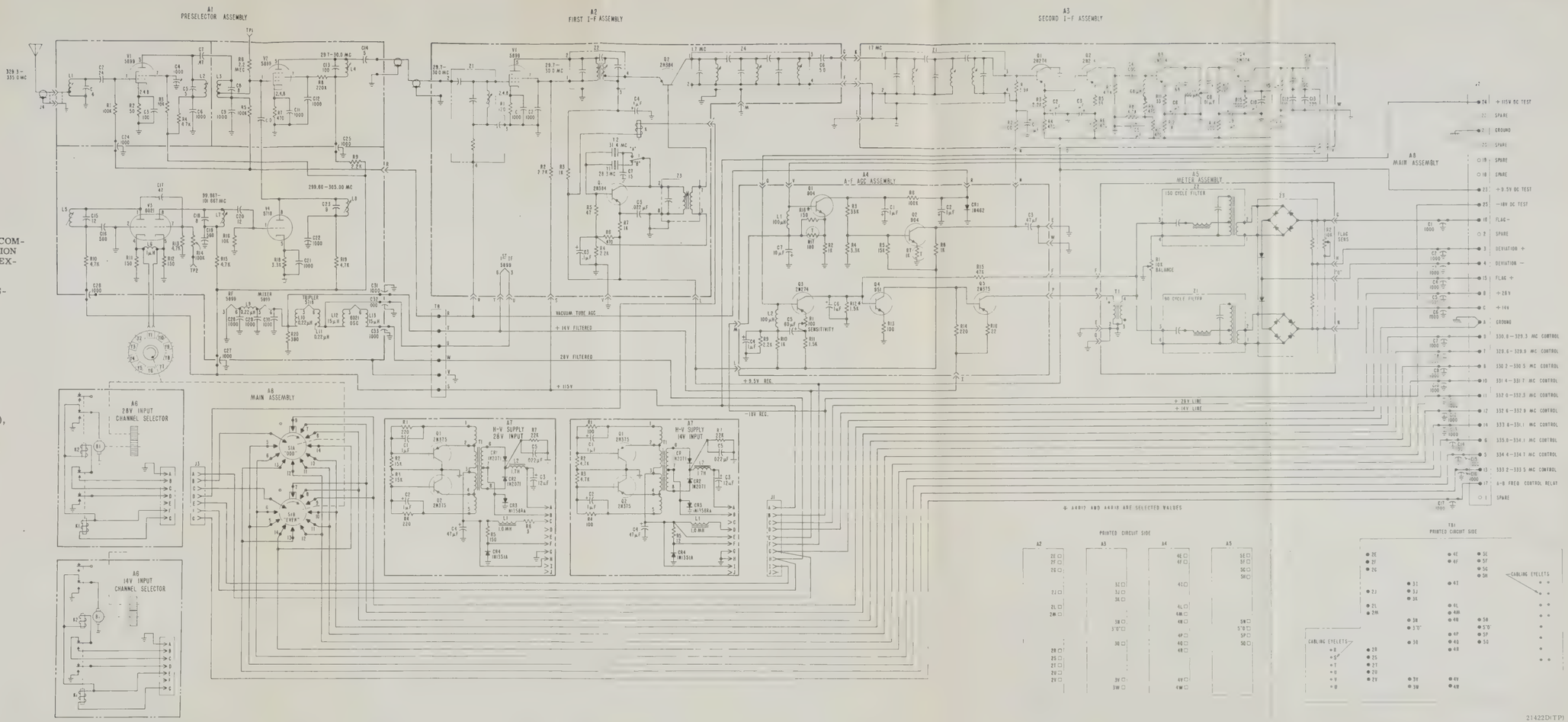
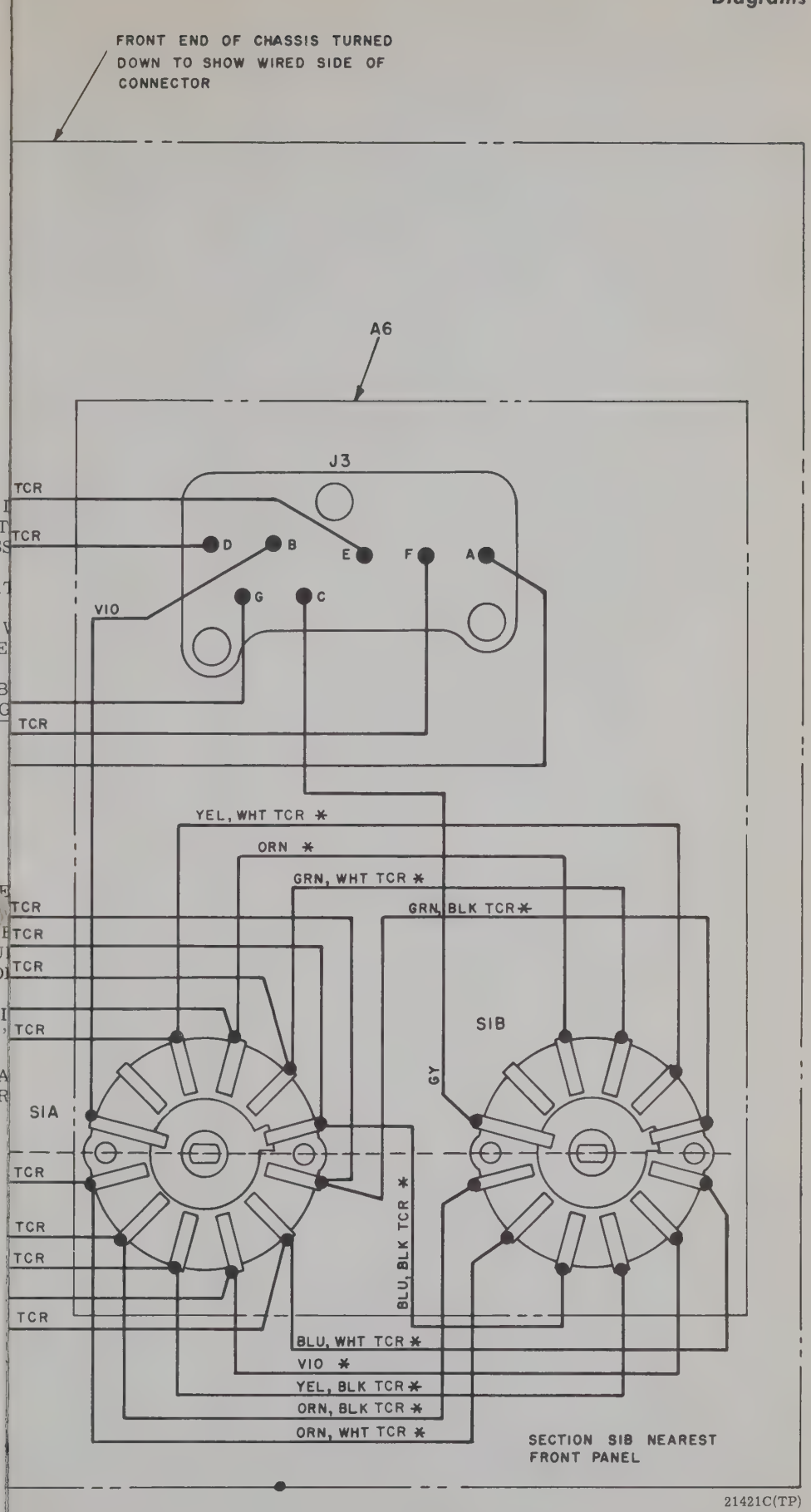


Figure 6–1. R-31A Receiver, Schematic Diagram



NOTES:

1. REFERENCE I
PLETE IDENT
WITH THE ASS

2. FOR SCHEMAT

3. ASSOCIATED V
CIRCUIT ASSE

ASSEMB
DESIG
A1
A2
A3
A4
A5
A6
A7

4. WIRES MAR E
STRANDED C
WITH AN A E
TEFLON INSU
PRESELECTO

5. TEFLON TUBI
MARKED "T."

6. SHADED AREA
SIDE OF BOAR

21421C(TP)

Figure 6–2. Main Assembly A8, Wiring Diagram

NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A8. FOR EXAMPLE, A8J1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. ASSOCIATED WIRING DIAGRAMS OF PLUG-IN PRINTED-CIRCUIT ASSEMBLIES ARE AS FOLLOWS:

ASSEMBLY DESIG	ASSEMBLY	FIGURE NO.
A1	PRESELECTOR	6-3
A2	FIRST I-F	6-4
A3	SECOND I-F	6-5
A4	AF/AGC	6-6
A5	METER	6-7
A6	CHANNEL SELECTOR	6-8
A7	POWER SUPPLY	6-9

4. WIRES MARKED WITH COLOR NOTE ONLY ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED. WIRES MARKED WITH AN ASTERISK (*) ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED. WIRES MARKED (A) ARE PART OF PRESELECTOR WIRING.
5. TEFLON TUBING (.072 I.D.) IS INSTALLED OVER WIRES MARKED "T."
6. SHADED AREA DENOTES UNETCHED COPPER ON OPPOSITE SIDE OF BOARD.

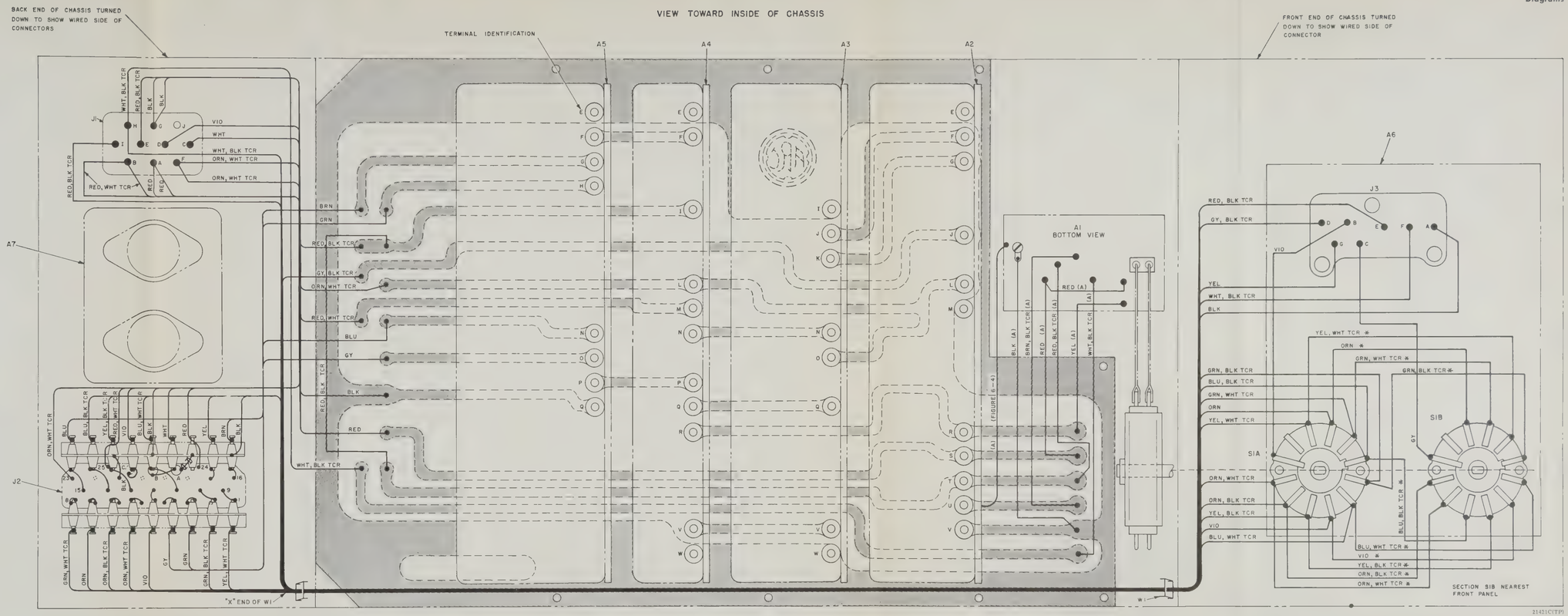


Figure 6-2. Main Assembly A8, Wiring Diagram

NOTES:

1. REFERENCE DESIGNATIONS ARE
PLETE IDENTIFICATION, PREFI
WITH THE ASSEMBLY DESIGNAT
A1C1.

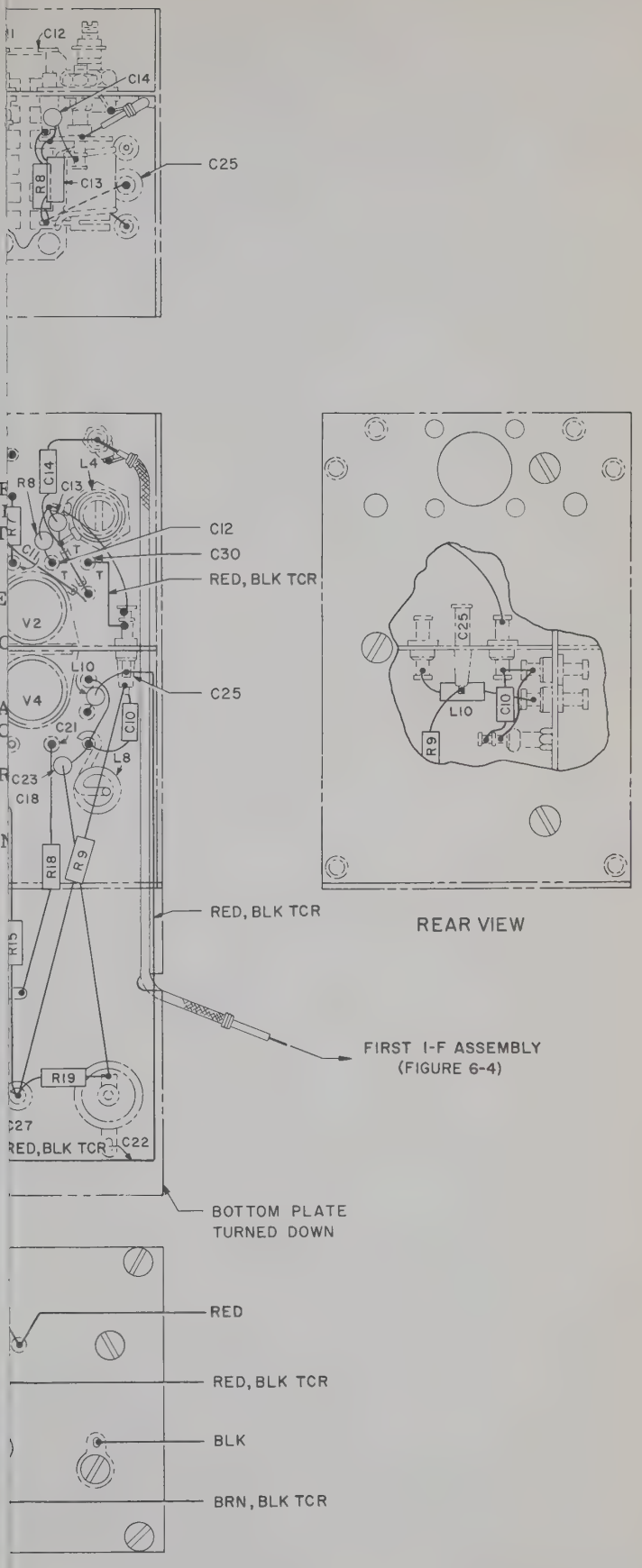
2. FOR SCHEMATIC DIAGRAM, SEE

3. WIRES MARKED WITH COLOR NO
COPPER, TEFLON INSULATED.

4. UNMARKED WIRES ARE NO. 22 A
COPPER UNLESS OTHERWISE NO

5. CONNECTIONS ARE OMITTED FR
CLARITY.

6. TEFLON TUBING (.020 I.D.) IS IN
MARKED "T."

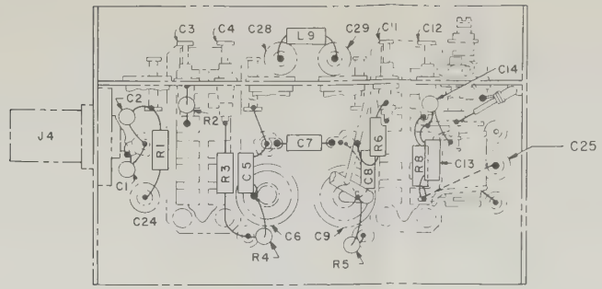


23015G(TP)

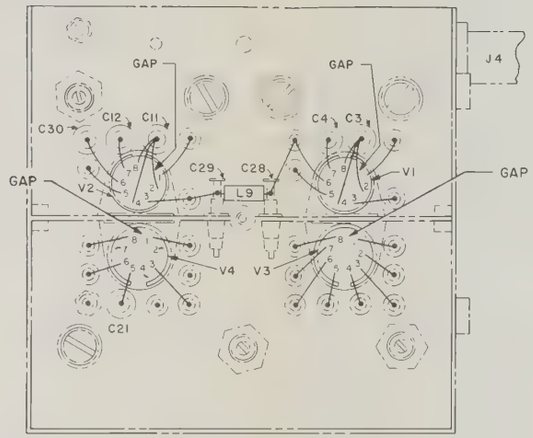
Figure 6–3. Preselector Assembly A1, Wiring Diagram

NOTES:

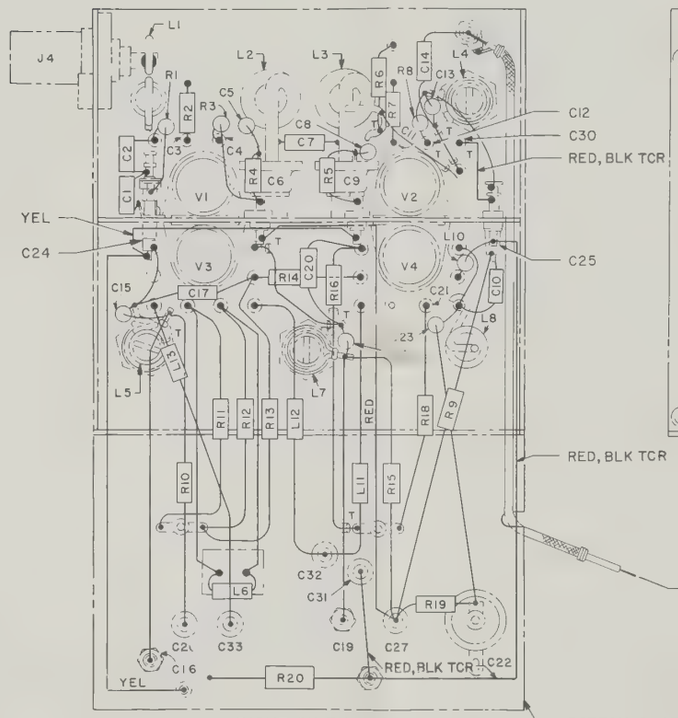
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A1; FOR EXAMPLE, A1C1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
4. UNMARKED WIRES ARE NO. 22 AWG BARE, SOLID, TINNED COPPER UNLESS OTHERWISE NOTED.
5. CONNECTIONS ARE OMITTED FROM SEVERAL VIEWS FOR CLARITY.
6. TEFLON TUBING (.020 I.D.) IS INSTALLED OVER WIRES MARKED "T."



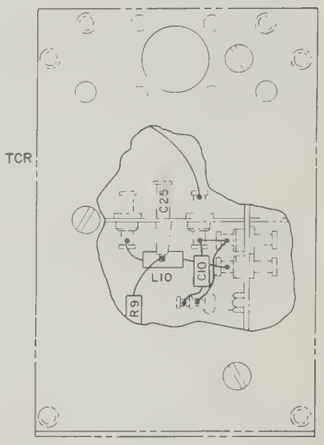
TOP VIEW



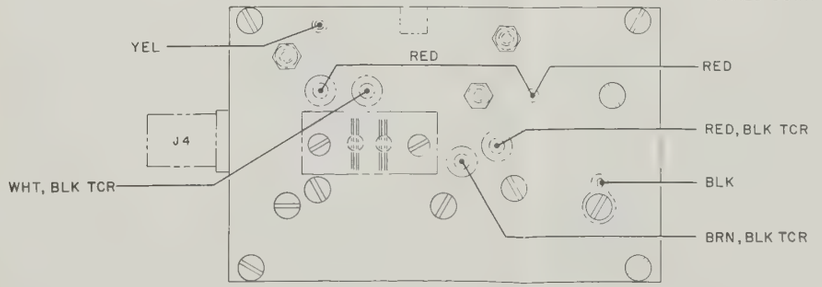
LEFT SIDE VIEW



RIGHT SIDE VIEW



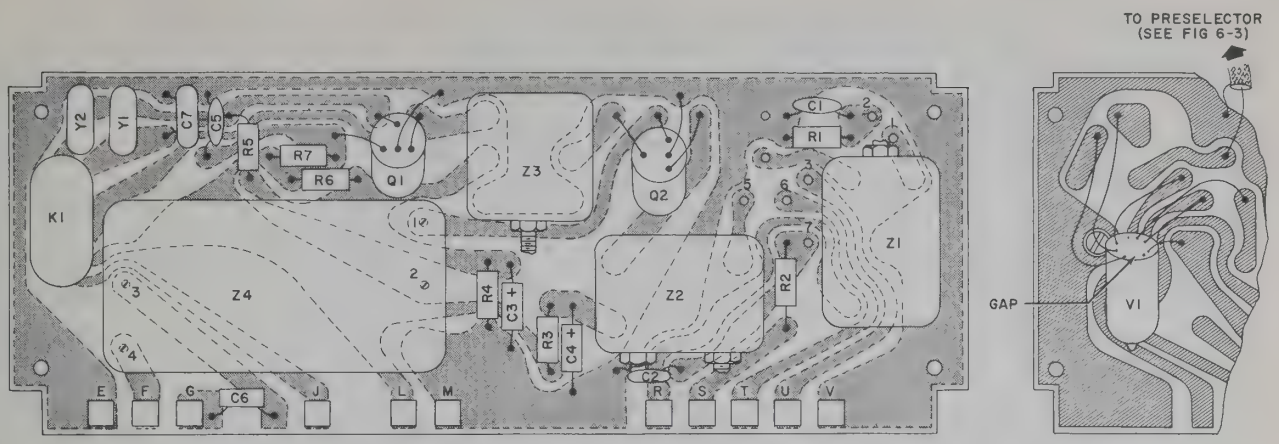
REAR VIEW



BOTTOM VIEW

23015G(TP)

Figure 6–3. Preselector Assembly A1, Wiring Diagram

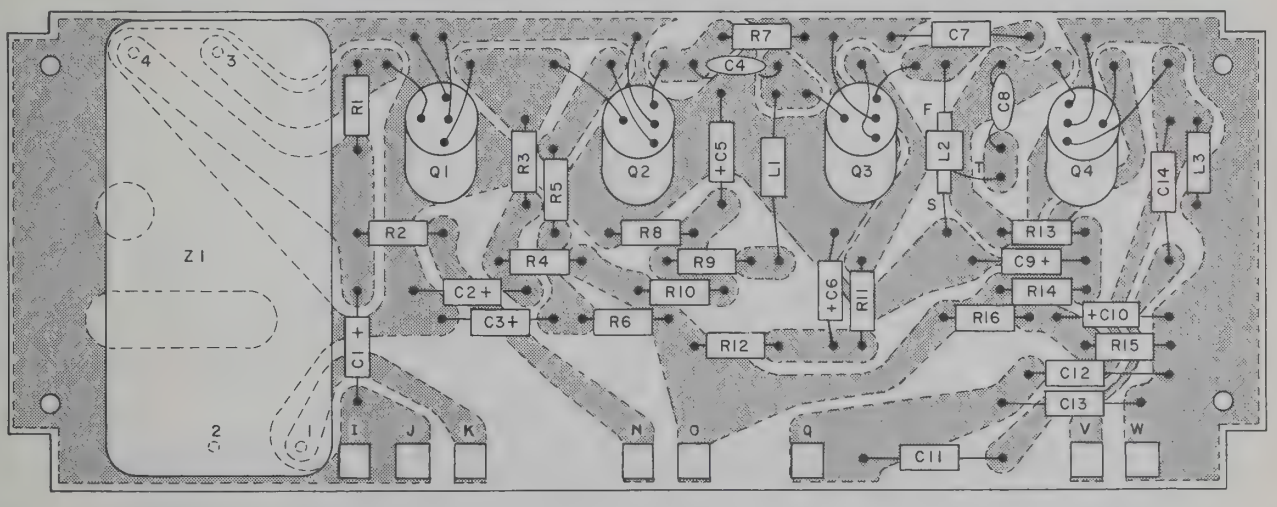


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A2; FOR EXAMPLE, A2Z1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. SHADED AREA DENOTES UNETCHED COPPER ON OPPOSITE SIDE OF BOARD.
4. TEFLON TUBING (.020 I.D.) IS INSTALLED OVER LEADS OF TUBE A2V1.

22331D(TP)

Figure 6–4. First I-f Assembly A2, Wiring Diagram

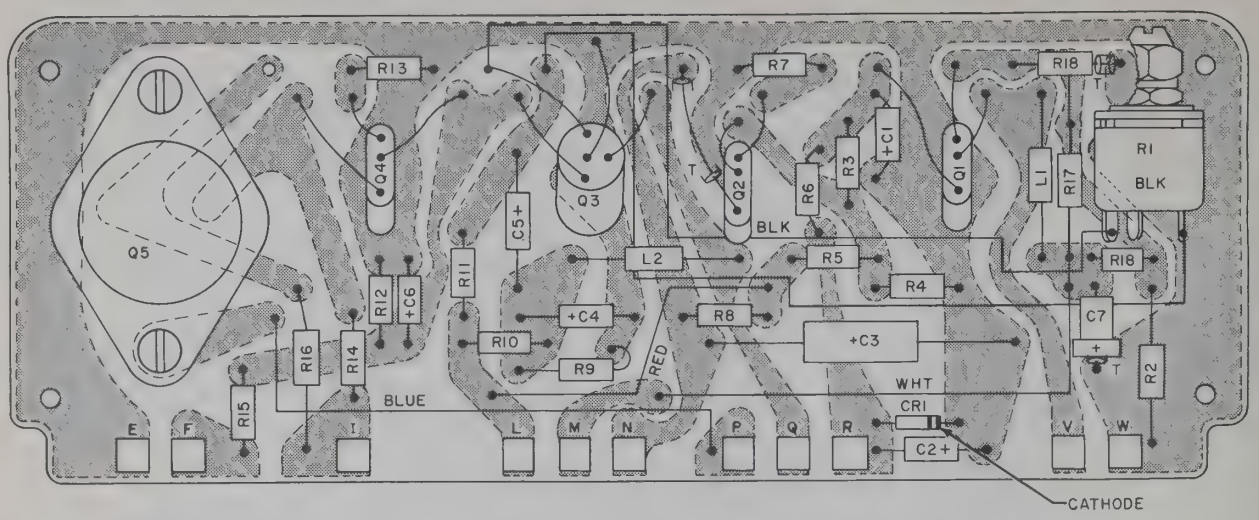


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A3; FOR EXAMPLE, A3Q1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. SHADED AREA DENOTES UNETCHED COPPER ON OPPOSITE SIDE OF BOARD.

22326D(TP)

Figure 6–5. Second I-f Assembly A3, Wiring Diagram

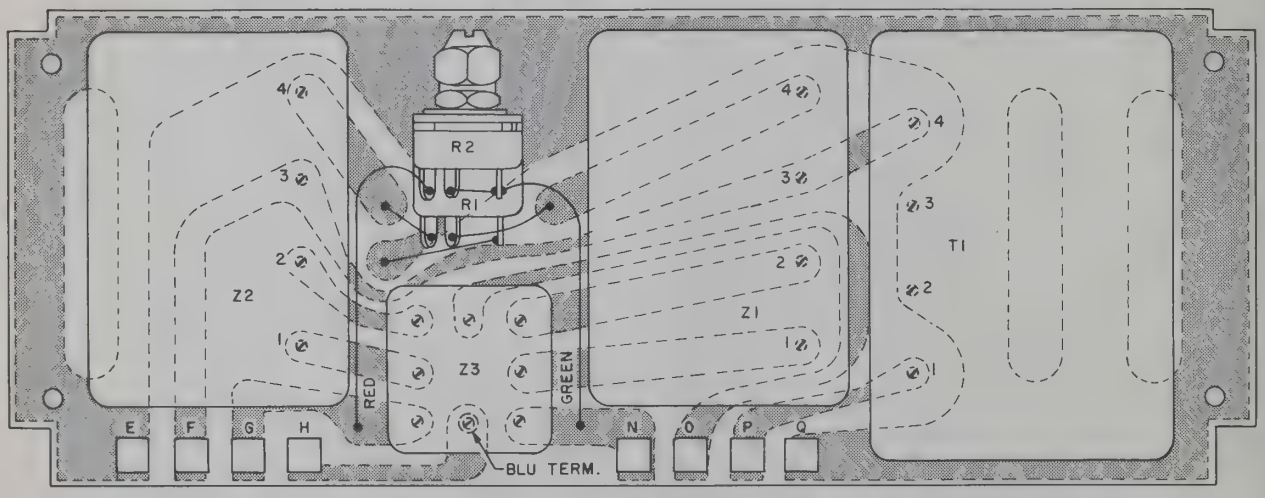


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A4; FOR EXAMPLE, A4R1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. WIRES MARKED WITH COLOR NOTE ARE NO. 22 AWG SOLID COPPER, TEFLON INSULATED.
4. TEFLON TUBING (.032 I.D.) IS INSTALLED OVER WIRES MARKED "T."
5. SHADED AREA DENOTES UNETCHED COPPER ON OPPOSITE SIDE OF BOARD.

22229E(TP)

Figure 6–6. Af-Agc Assembly A4, Wiring Diagram

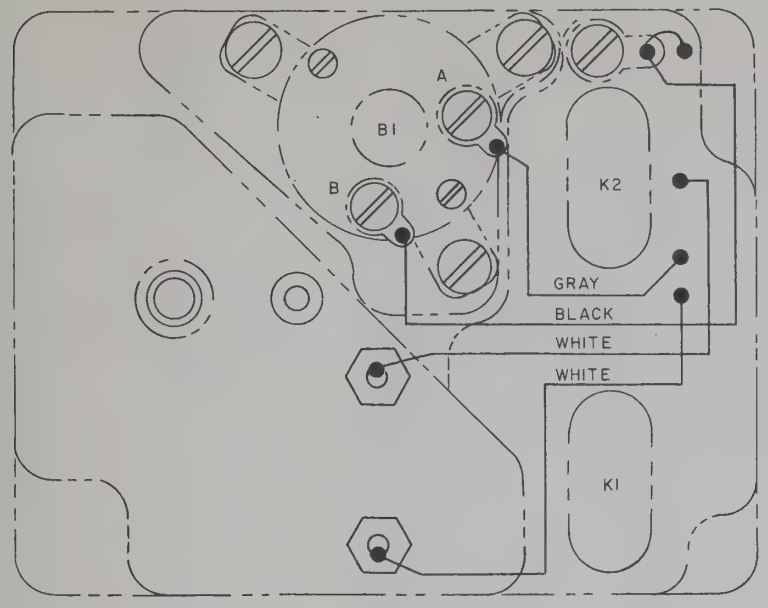


NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A5; FOR EXAMPLE, A5T1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED.
4. UNMARKED WIRES ARE NO. 24 AWG BARE, SOLID, TINNED COPPER.
5. SHADED AREA DENOTES UNETCHED COPPER ON OPPOSITE SIDE OF BOARD.

22347A(TP)

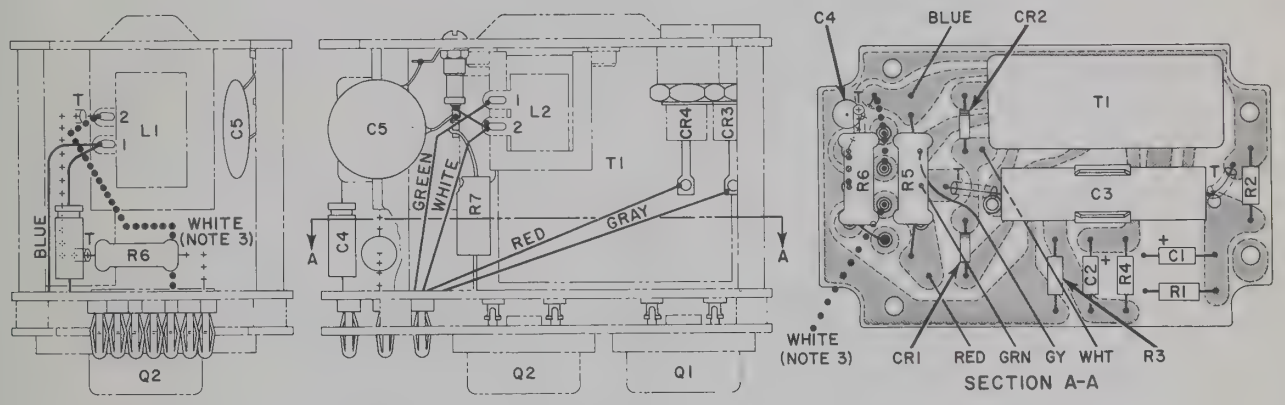
Figure 6–7. Meter Assembly A5, Wiring Diagram



NOTES:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A6; FOR EXAMPLE, A6B1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED.
4. UNMARKED WIRE IS NO. 20 AWG BARE, SOLID, TINNED COPPER.

22976B(TP)

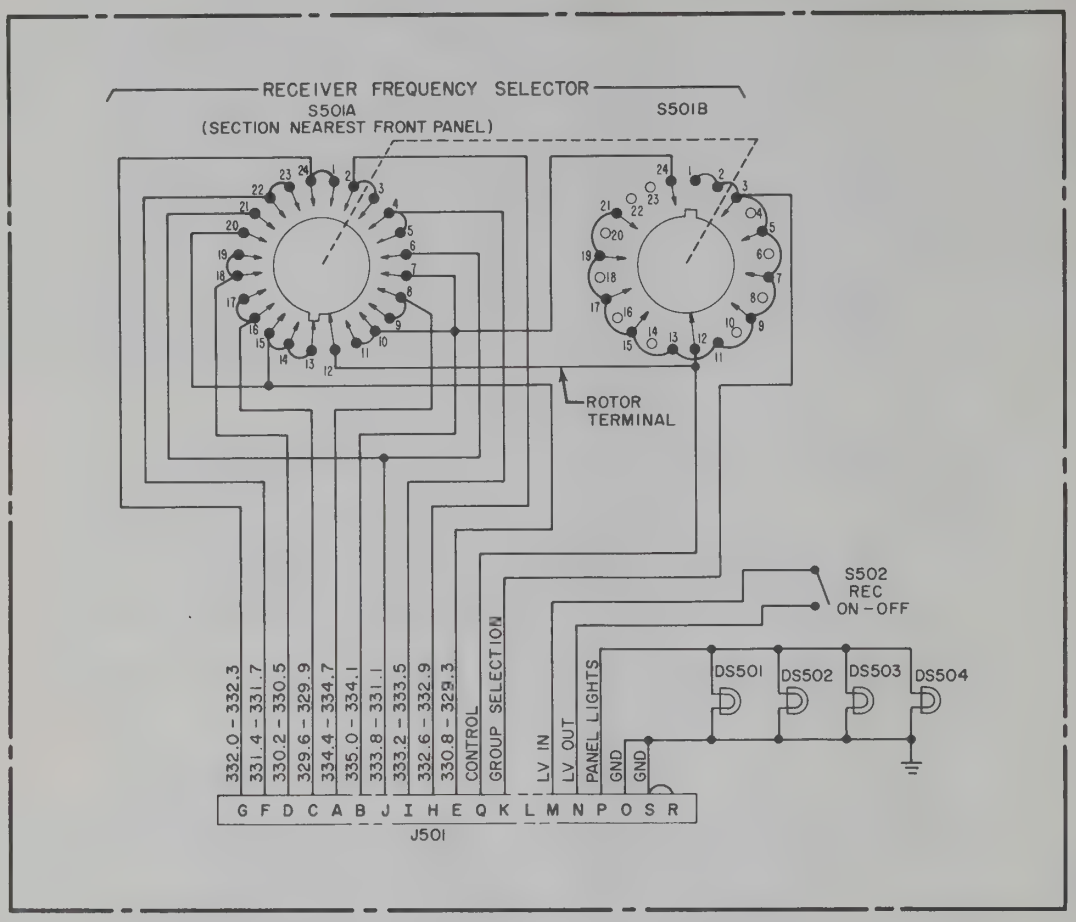
Figure 6–8. Channel Selector A6, Wiring Diagram



NOTES:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX THE PART DESIGNATION WITH THE ASSEMBLY DESIGNATION, A7; FOR EXAMPLE, A7L1.
2. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
3. IN 14-VOLT UNITS, WIRE SHOWN AS ••••••• IS CONNECTED. IN 28-VOLT UNITS, RESISTOR R6 AND WIRE SHOWN AS + + + + IS CONNECTED.
4. TEFLON TUBING (.064 I.D.) IS INSTALLED OVER WIRES MARKED "T."
5. WIRES MARKED WITH COLOR NOTE ARE NO. 24 AWG STRANDED COPPER, TEFLON INSULATED.
6. UNMARKED WIRES ARE NO. 20 AWG BARE, SOLID, TINNED COPPER.
7. SHADED AREA DENOTES UNETCHED COPPER ON OPPOSITE SIDE OF BOARD.

22886D(TP)

Figure 6–9. Power Supply Assembly A7, Wiring Diagram

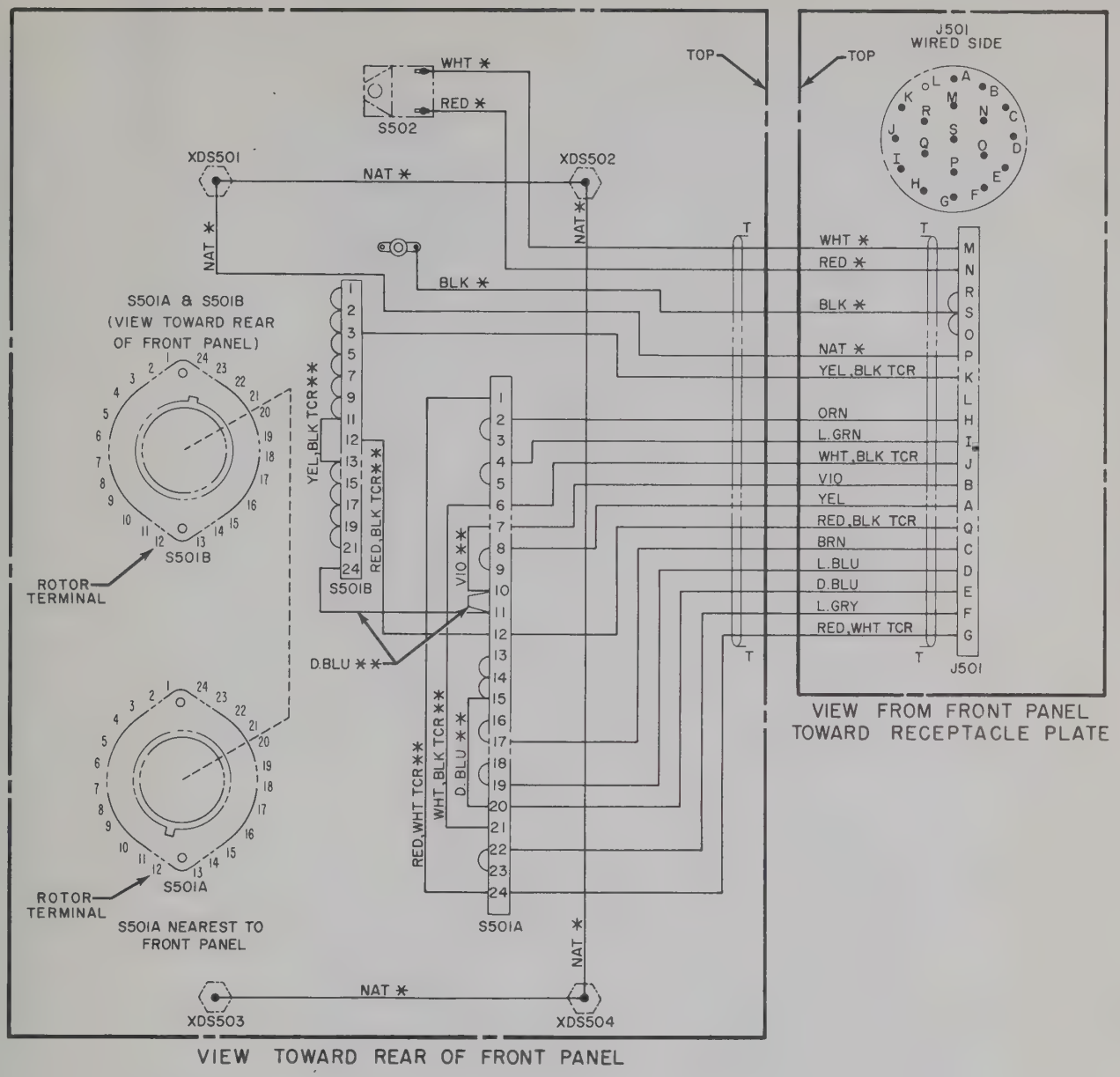


NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-11.
2. SWITCH SECTIONS ARE VIEWED FROM KNOB END OF SWITCH.

21702B

Figure 6–10. C-69A Control Unit, Schematic Diagram

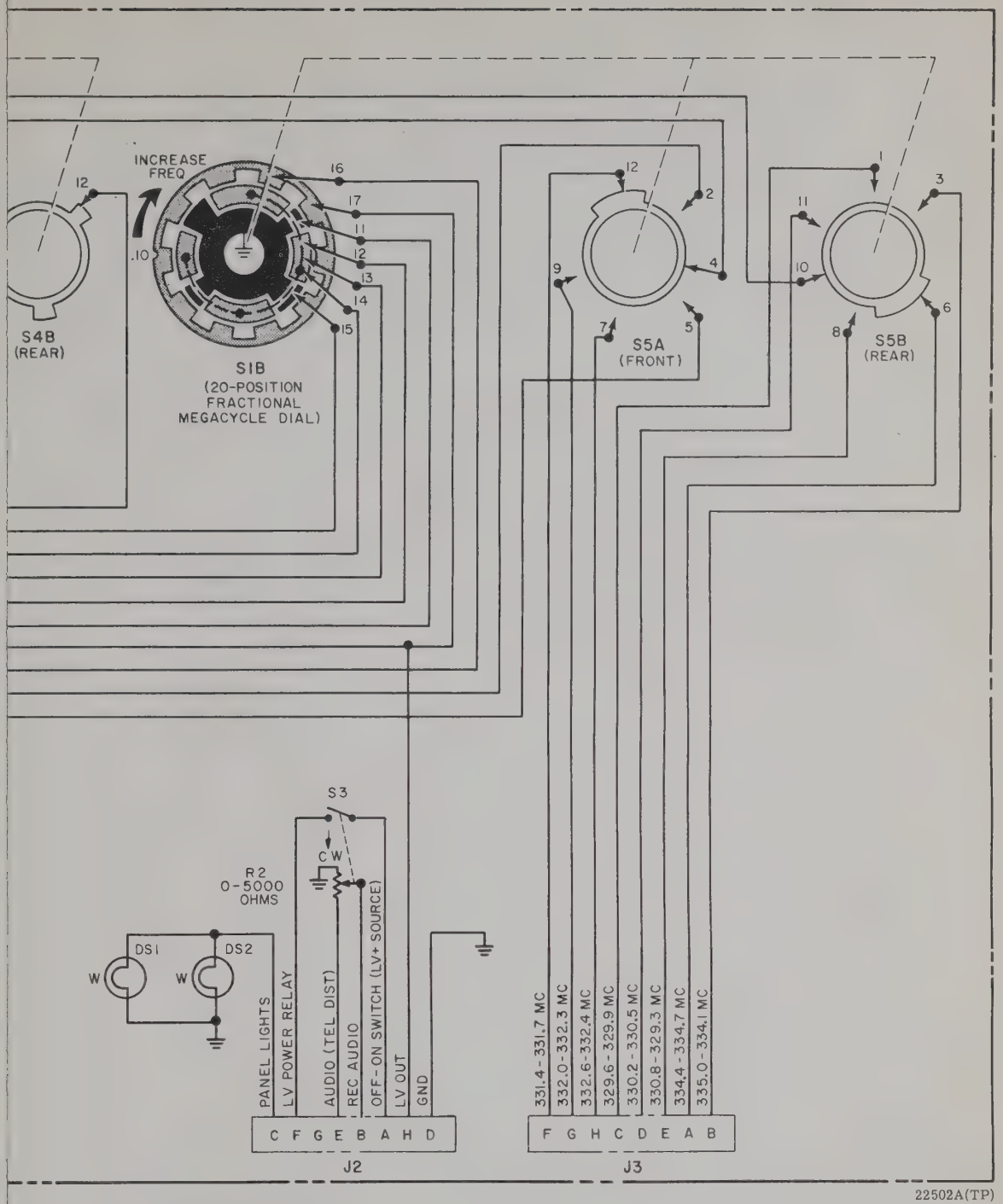


NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-10.
2. WIRES MARKED WITH COLOR NOTE ARE NO. 22 AWG STRANDED COPPER, TEFLON INSULATED.
3. WIRES MARKED WITH COLOR NOTE AND ASTERISK (*) ARE NO. 20 AWG STRANDED COPPER, TEFLON INSULATED.
4. WIRES MARKED WITH COLOR NOTE AND DOUBLE ASTERISK (**) ARE NO. 24 AWG SOLID COPPER, TEFLON INSULATED.
5. UNMARKED WIRES ARE NO. 22 AWG SOLID, BARE, TINNED COPPER.
6. TEFLON TUBING OF APPROPRIATE SIZE IS INSTALLED OVER GROUP OF WIRES MARKED "T."

21701B

Figure 6–11. C-69A Control Unit, Wiring Diagram



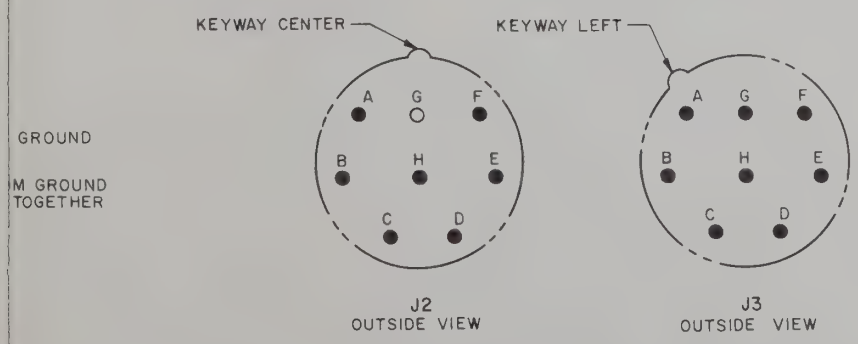


Figure 6–12. C-88A Control Unit, Schematic Diagram

NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-13.
2. SWITCH SECTIONS S1A AND S1B ARE SHOWN AT 108.00 MC. FOR IDENTIFICATION OF SWITCH TERMINALS SEE FIGURE 6-13.
3. S1A CONTROLS TERMINAL GROUP H, I, J, K, L OF J1. S1B CONTROLS TERMINAL GROUP N, O, P, Q, R OF J1. AT EACH POSITION OF S1A AND S1B CERTAIN TERMINALS IN EACH GROUP ARE GROUNDED AND THE OTHER TERMINALS IN THE GROUP ARE CONNECTED TOGETHER FREE FROM GROUND. REFER TO TABLE II.
4. TERMINALS D AND M OF J1 AND H OF J2 ARE CONNECTED TOGETHER FREE FROM GROUND AT ODD-TENTH POSITIONS OF S1B (.10, .30, ETC.).
5. SWITCH S4 (A & B) IS SHOWN AT 108 MC AND IS CONTROLLED BY THE MEGACYCLE DIAL. GROUNDED TERMINALS ARE SHOWN IN TABLE III. SWITCH S5 (A & B) IS SHOWN AT .10 MC AND IS CONTROLLED BY THE FRACTIONAL MEGACYCLE DIAL. GROUNDED TERMINALS ARE SHOWN IN TABLE III.

TABLE I
ARC PART NUMBERS

Ref Desig	ARC Part No.
DS1(14V)	8679
DS1(28V)	8622
DS2(14V)	8679
DS2(28V)	8622
J1	12357
J2	12097
J3	12355
R1	23738
R2	23115
S1A	21689
S1B	21697
S3	23115
S4	23729
S5	23728
XDS1	16293
XDS2	16293

TABLE II
TABULATION OF GROUNDED TERMINALS IN EACH GROUP (SWITCH S1)

S1A	J1 Terminal Group H, I, J, K, L	S1B	J1 Terminal Group N, O, P, Q, R
108	L, K	.00	N, O
109	L, K, J	.10	N, R
110	L, H	.20	Q
111	L, K, J, I	.30	P
112	I	.40	O
113	K, J, I, H	.50	N
114	J	.60	R
115	L, J, I, H	.70	Q, R
116	K	.80	P, Q
117	K, I, H	.90	O, P
118	L	.00	N, O
119	L, J, H	.10	N, R
120	H	.20	Q
121	K, I	.30	P
122	I, H	.40	O
123	J, H	.50	N
124	J, I	.60	R
125	L, I	.70	Q, R
126	K, J	.80	P, Q
Space	L, K, H	.90	O, P

TABLE III. TABULATION OF GROUNDED TERMINALS (SWITCHES S4 & S5)

S4 (A & B) and S5 (A & B)	Grounded Terminals for Paired Glide Slope Frequency		Paired Glide Slope Frequency MC
	J3	J1	
108.10	A	C	334.7
108.30	B	C	334.1
108.50	C	C	329.9
108.70	D	C	330.5
108.90	E	C	329.3
109.10	F		331.4
109.30	G		332.0
109.50	H		332.6
109.70		A	333.2
109.90		B	333.8
110.10	A		334.4
110.30	B		335.0
110.50	C		329.6
110.70	D		330.2
110.90	E		330.8
111.10	F	C	331.7
111.30	G	C	332.3
111.50	H	C	332.9
111.70		A, C	333.5
111.90		B, C	331.1

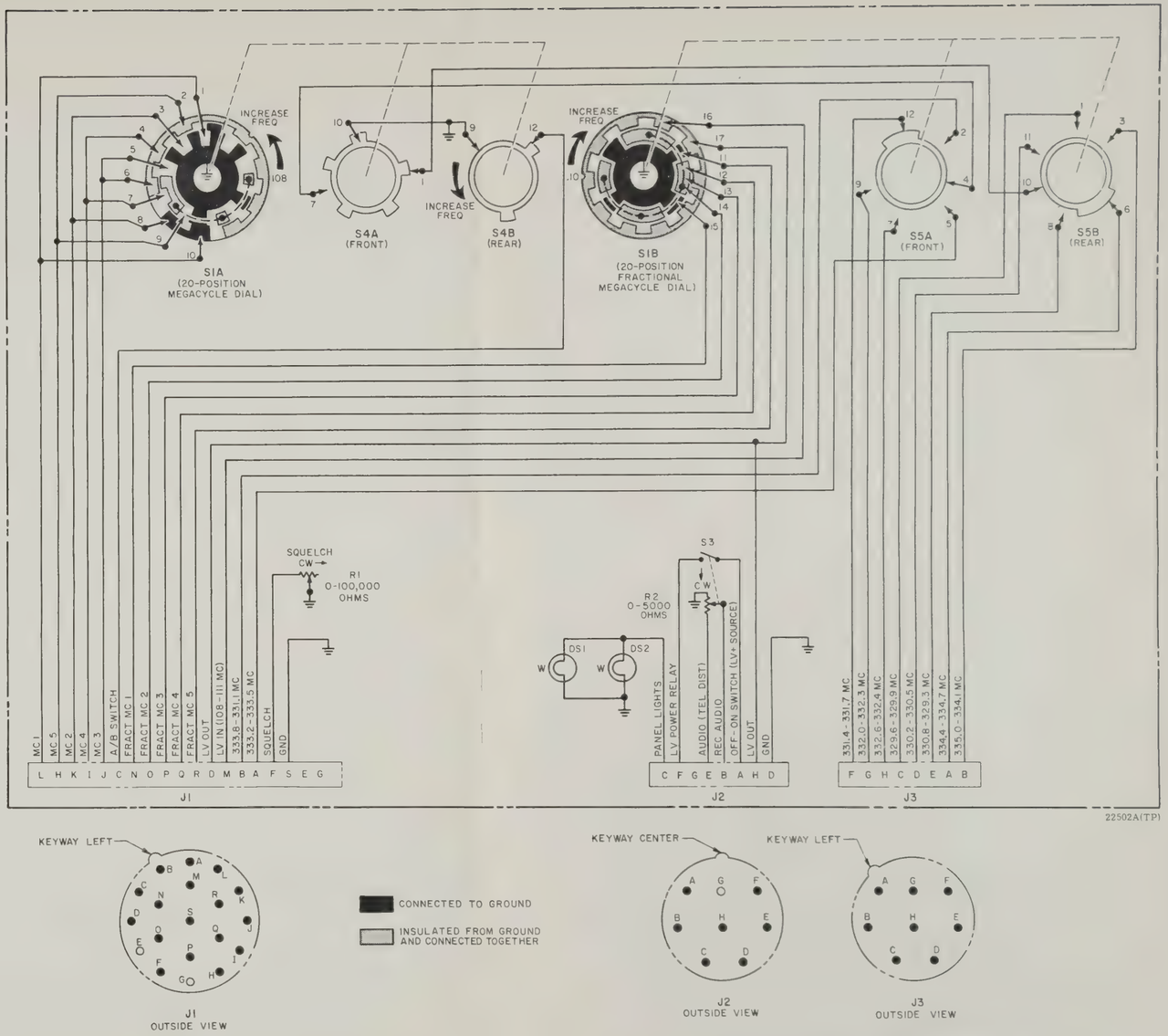


Figure 6–12. C-88A Control Unit, Schematic Diagram

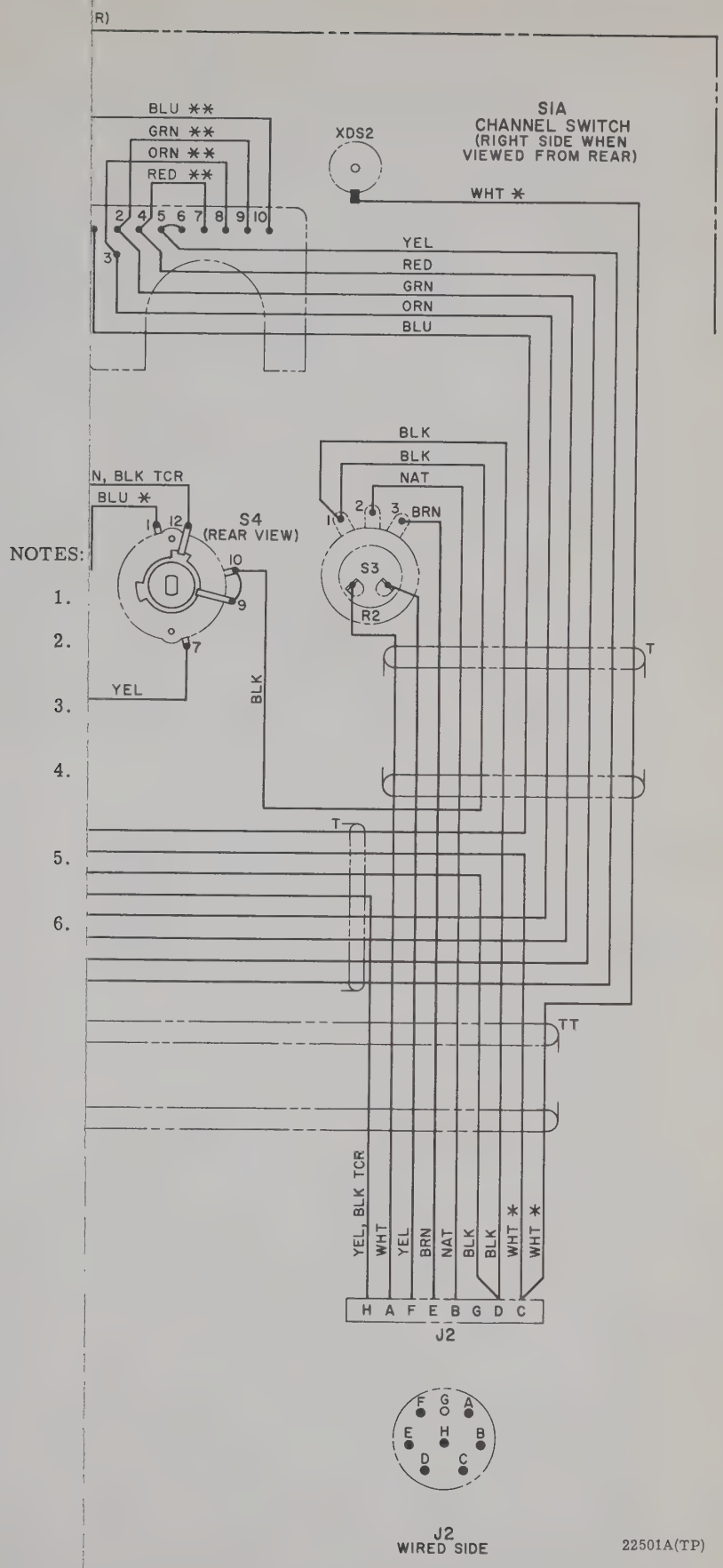


Figure 6–13. C-88A Control Unit, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-12.
2. WIRES MARKED WITH A COLOR NOTE ARE NO. 24 STRANDED COPPER, TEFLON INSULATED.
3. WIRES MARKED WITH A COLOR NOTE AND AN ASTERISK (*) ARE NO. 22 SOLID COPPER, TEFLON INSULATED.
4. WIRES MARKED WITH A COLOR NOTE AND A DOUBLE ASTERISK (**) ARE NO. 24 SOLID COPPER, TEFLON INSULATED.
5. UNMARKED WIRES ARE NO. 24 BARE, SOLID, TINNED COPPER.
6. TRANSPARENT VINYLITE TUBING (0.258 I.D.) IS INSTALLED OVER GROUPS OF WIRES MARKED "T." TRANSPARENT VINYLITE TUBING (0.313 I.D.) IS INSTALLED OVER GROUPS OF WIRES MARKED "TT."

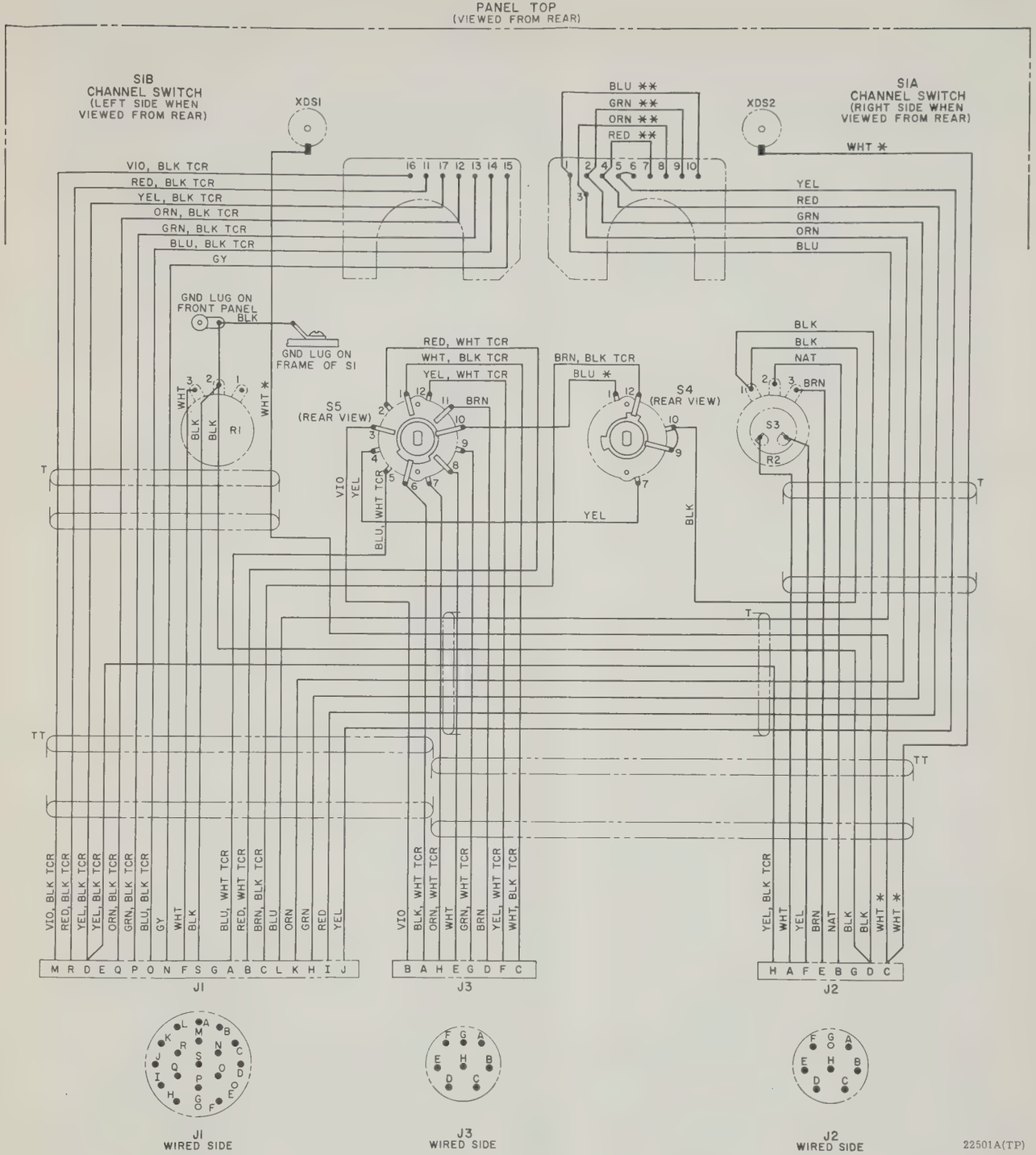
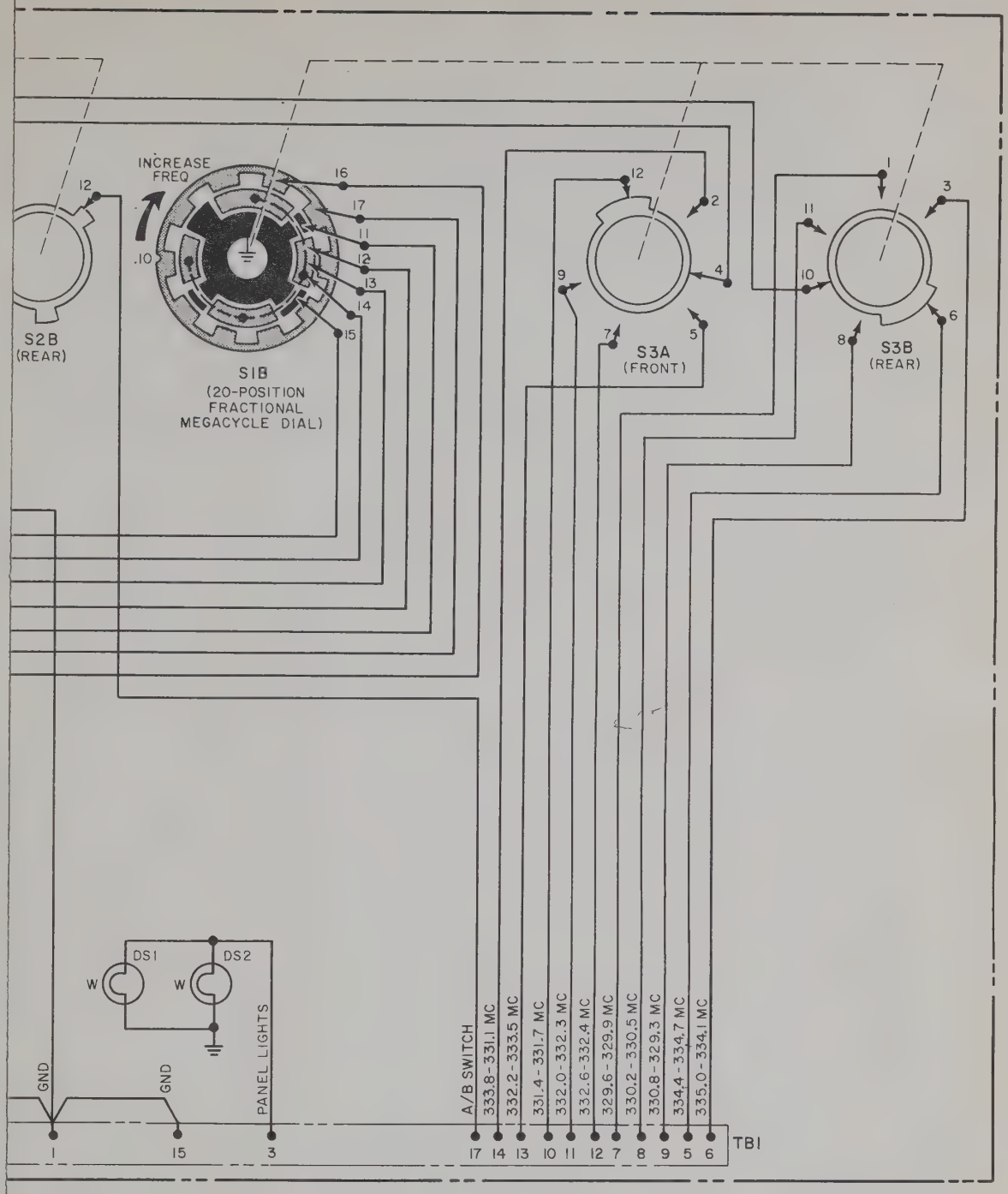


Figure 6–13. C-88A Control Unit, Wiring Diagram



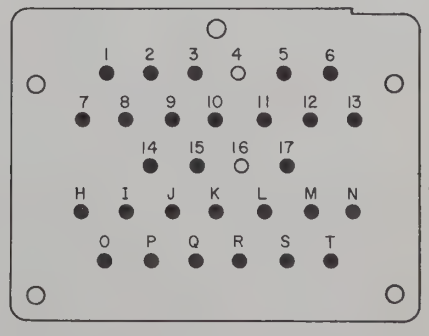


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Figure 6–14. CC-12A Custom Control Unit, Schematic Diagram

NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-15.
2. SWITCH SECTIONS S1A AND S1B ARE SHOWN AT 108.00 MC. FOR IDENTIFICATION OF SWITCH TERMINALS, SEE FIGURE 6-15.
3. S1A CONTROLS TERMINAL GROUP H, I, J, K, L. S1B CONTROLS TERMINAL GROUP N, O, P, Q, R. AT EACH POSITION OF S1A AND S1B CERTAIN TERMINALS IN EACH GROUP ARE GROUNDED AND THE OTHER TERMINALS IN THE GROUP ARE CONNECTED TOGETHER FREE FROM GROUND. REFER TO TABLE II.
4. TERMINALS 2, M, AND T ARE CONNECTED TOGETHER FREE FROM GROUND AT ODD-TENTH POSITIONS OF S1B (.10, .30, ETC.).
5. SWITCH S2 (A & B) IS SHOWN AT 108 MC AND IS CONTROLLED BY THE MEGACYCLE DIAL. GROUNDED TERMINALS ARE SHOWN IN TABLE III. SWITCH S3 (A & B) IS SHOWN AT .10 MC AND IS CONTROLLED BY THE FRACTIONAL MEGACYCLE DIAL. GROUNDED TERMINALS ARE SHOWN IN TABLE III.

TABLE I
ARC PART NUMBERS

Ref Desig	ARC Part No.
DS1(14V)	21760
DS1(28V)	8622
DS2(14V)	21760
DS2(28V)	8622
S1A	21689
S1B	21697
S2	23729
S3	23728
TB1	23846
XDS1	23861
XDS2	23861

TABLE II
TABULATION OF GROUNDED TERMINALS IN EACH GROUP (SWITCH S1)

S1A	TB1 Terminal Group H, I, J, K, L	S1B	TB1 Terminal Group N, O, P, Q, R
108	L, K	.00	N, O
109	L, K, J	.10	N, R
110	L, H	.20	Q
111	L, K, J, I	.30	P
112	I	.40	O
113	K, J, I, H	.50	N
114	J	.60	R
115	L, J, I, H	.70	Q, R
116	K	.80	P, Q
117	K, I, H	.90	O, P
118	L	.00	N, O
119	L, J, H	.10	N, R
120	H	.20	Q
121	K, I	.30	P
122	I, H	.40	O
123	J, H	.50	N
124	J, I	.60	R
125	L, I	.70	Q, R
126	K, J	.80	P, Q
Space	L, K, H	.90	O, P

TABLE III. TABULATION OF GROUNDED TERMINALS (SWITCHES S2 & S3)

S2 (A & B) and S3 (A & B)	TB1 Grounded Terminals for Paired Glide Slope Frequency	Paired Glide Slope Frequency MC
108.10	5, 17	334.7
108.30	6, 17	334.1
108.50	7, 17	329.9
108.70	8, 17	330.5
108.90	9, 17	329.3
109.10	10	331.4
109.30	11	332.0
109.50	12	332.6
109.70	13	333.2
109.90	14	333.8
110.10	5	334.4
110.30	6	335.0
110.50	7	329.6
110.70	8	330.2
110.90	9	330.8
111.10	10, 17	331.7
111.30	11, 17	332.3
111.50	12, 17	332.9
111.70	13, 17	333.5
111.90	14, 17	331.1

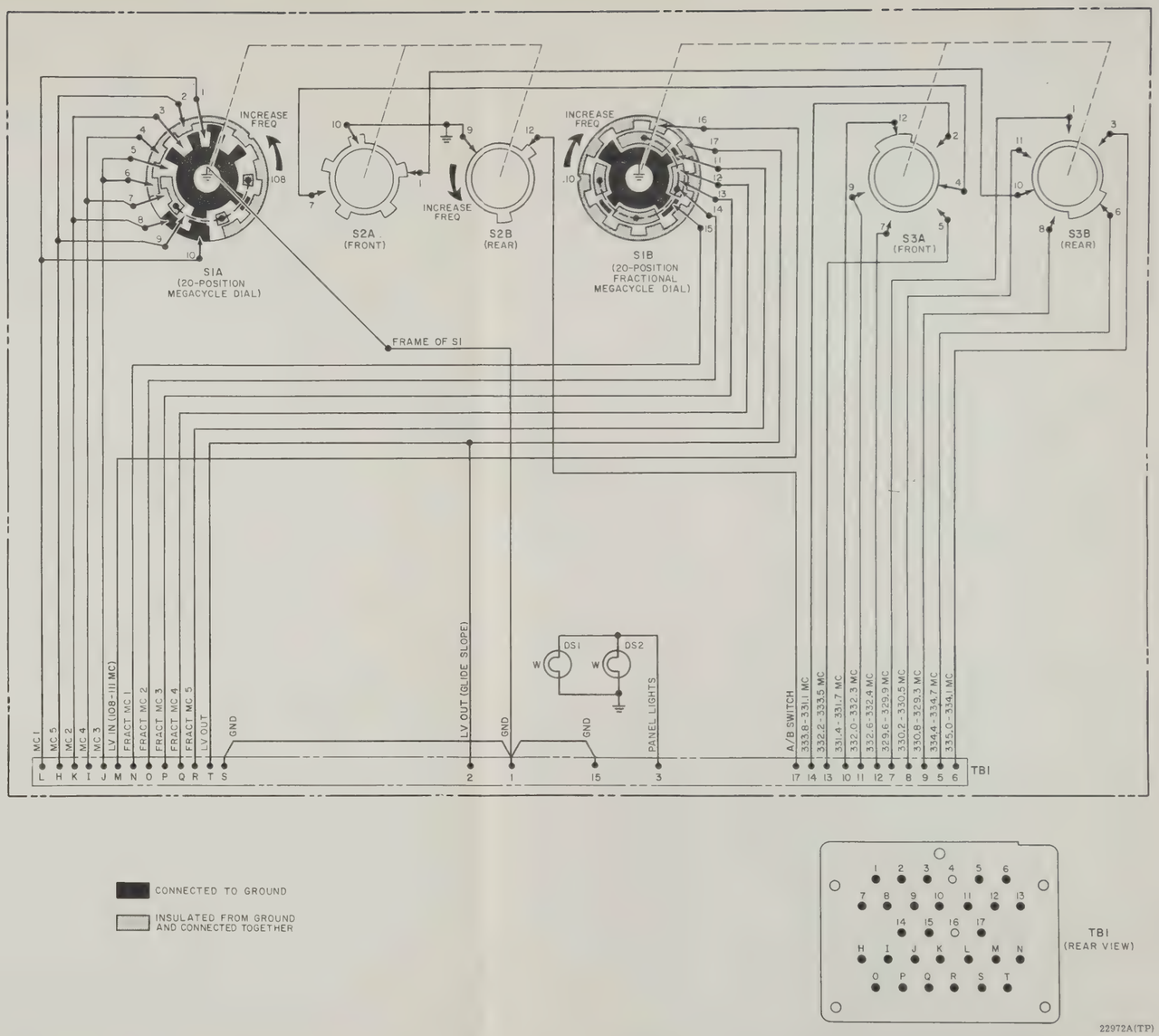
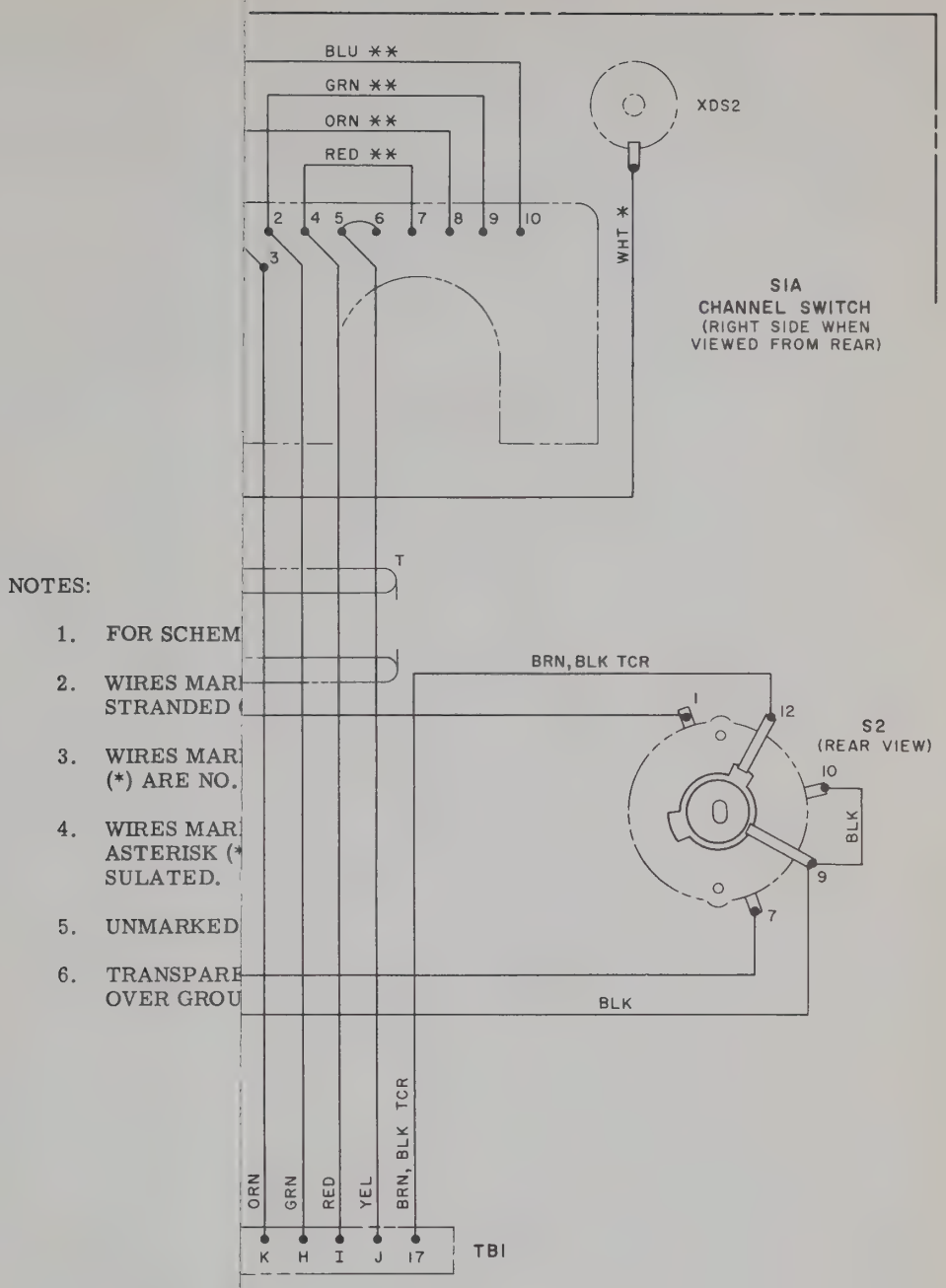


Figure 6–14. CC-12A Custom Control Unit, Schematic Diagram



NOTES:

1. FOR SCHEM
2. WIRES MARI
   STRANDED (
3. WIRES MARI
   (*) ARE NO.
4. WIRES MARI
   ASTERISK (*
   SULATED.
5. UNMARKED
6. TRANSPARE
   OVER GROU

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Figure 6–15. CC-12A Custom Control Unit, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-14.
2. WIRES MARKED WITH A COLOR NOTE ARE NO. 24 STRANDED COPPER, TEFLON INSULATED.
3. WIRES MARKED WITH A COLOR NOTE AND AN ASTERISK (*) ARE NO. 22 SOLID COPPER, TEFLON INSULATED.
4. WIRES MARKED WITH A COLOR NOTE AND A DOUBLE ASTERISK (**) ARE NO. 24 SOLID COPPER, TEFLON INSULATED.
5. UNMARKED WIRE IS NO. 24 BARE, SOLID, TINNED COPPER.
6. TRANSPARENT VINYLITE TUBING (0.313 I.D.) IS INSTALLED OVER GROUPS OF WIRES MARKED "T."

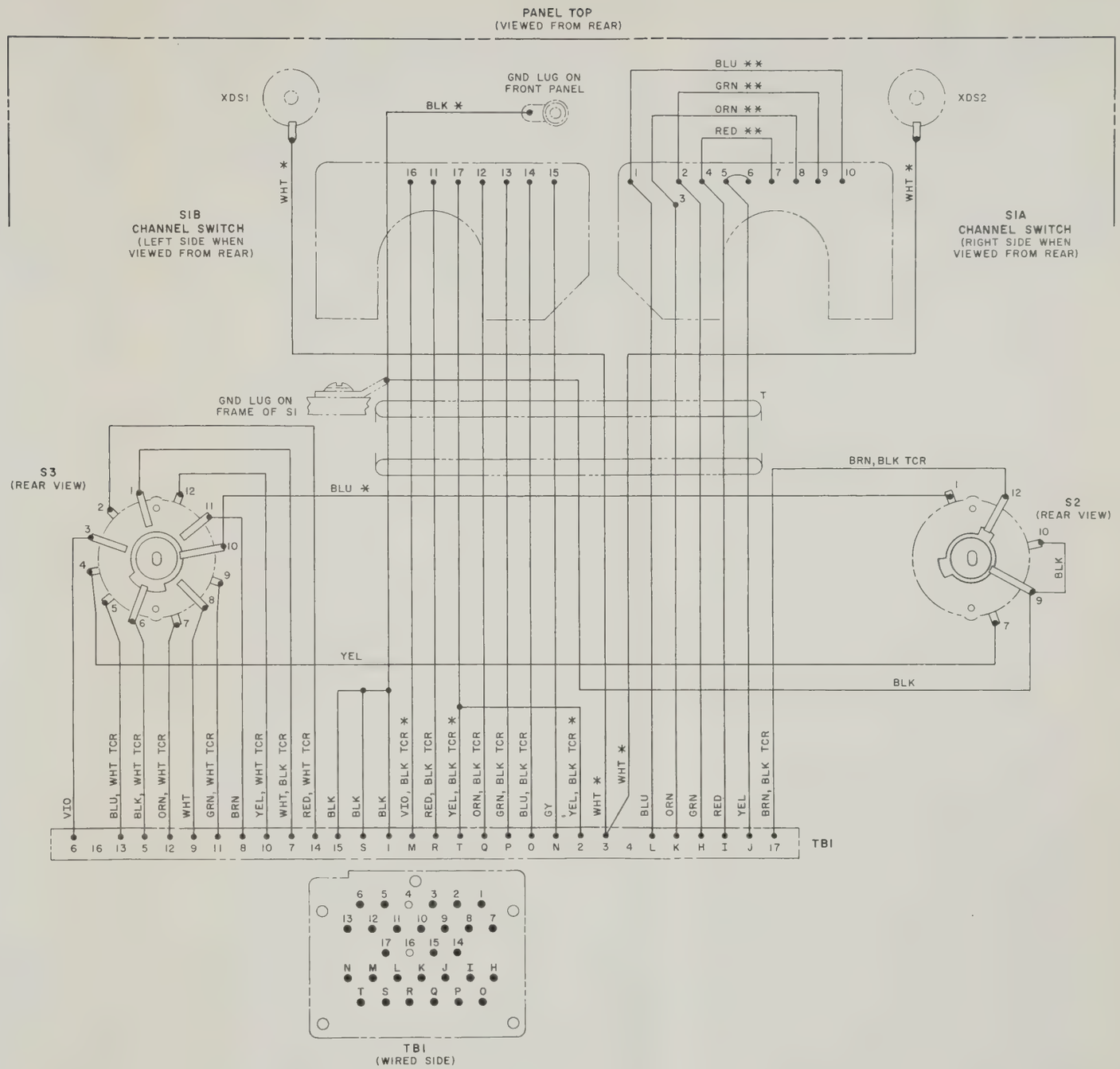

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Figure 6–15. CC-12A Custom Control Unit, Wiring Diagram

SECTION VII

PARTS LIST

MANUFACTURERS' CODES

Code	Name and Address
AB	Allen-Bradley Co. Milwaukee, Wisconsin
AEV	Aerovox Corporation New Bedford, Massachusetts
AMP	Amphenol-Borg Electronics Corp. Chicago, Illinois
CGT	Cambridge Thermionic Corp. Cambridge, Massachusetts
CLIP	Clifton Precision Products Co. Clifton Heights, Pennsylvania
CMPB	Colin Campbell Co., Inc. Danbury, Connecticut
CUT	Cutler-Hammer Milwaukee, Wisconsin
DABU	Dale Products, Inc. Columbus, Nebraska
DECN	Delevan Electronics Corp. East Aurora, New York
EMM	Electro Motive Mfg. Co. Willimantic, Connecticut
ERC	Erie Resistor Corp. Erie, Pennsylvania
FML	Fansteel Metallurgical Corp. North Chicago, Illinois
GBR	Globar Division Carborundum Co. Niagara Falls, New York
GE	General Electric Co. Schenectady, New York
GMC	Grimes Manufacturing Co. Urbana, Ohio
JFE	Jeffers Electronics Corp. St. Mary's, Pennsylvania
OAK	Oak Manufacturing Co. Chicago, Illinois
PK	Parker-Kalon Division General American Transportation Corp. Clifton, New Jersey
SH	Shakeproof Division Illinois Tool Works Elgin, Illinois
SLM	Solar Manufacturing Corp. New York, New York
SPR	Sprague Electric Co. North Adams, Massachusetts
TI	Texas Instruments, Inc. Semiconductor-Components Division Houston, Texas
UNT	United Transformer Co. New York, New York
WIQ	Winchester Electronics Co., Inc. Norwalk, Connecticut
WKI	Waldes Kohinoor, Inc. Long Island City, New York

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
	A1, PRESELECTOR ASSEMBLY, ARC-22405		
C1	CAPACITOR, Fixed, ceramic, 4 μμf ±0.25 μμf, 500 vdcw	8791-9401	
C2	CAPACITOR, Fixed, ceramic, 24 μμf ±5 per cent, 500 vdcw	8769-0240	MIL CC20UJ240J
C3	CAPACITOR, Fixed, ceramic, 100 μμf ±10 per cent, 500 vdcw	8932-0101	SLM CF1208101
C4	CAPACITOR, Fixed, ceramic, 1000 μμf ±20 per cent, 500 vdcw	8832	SLM CF123XD102Z3K
C5	CAPACITOR, Fixed, ceramic, 5 μμf ±0.25 μμf, 500 vdcw	8791-9501	
C6	CAPACITOR, Fixed, mica, 1000 μμf ±10 per cent, 500 vdcw	22984	
C7	CAPACITOR, Fixed, ceramic, 0.47 μμf ±5 per cent, 500 vdcw	8879-9472	
C8	CAPACITOR, Fixed, ceramic, 8 μμf ±0.25 μμf, 500 vdcw	8791-9801	
C9	CAPACITOR, Fixed, same as C6		
C10	CAPACITOR, Fixed, ceramic, 1 μμf ±0.25 μμf, 500 vdcw	8769-9101	MIL CC20UK010C
C11	CAPACITOR, Fixed, same as C4		
C12	CAPACITOR, Fixed, same as C4		
C13	CAPACITOR, Fixed, ceramic, 100 μμf ±1 per cent, 500 vdcw	8856	AEV CN-7-100
C14	CAPACITOR, Fixed, same as C5		
C15	CAPACITOR, Fixed, ceramic, 12 μμf ±2 per cent, 500 vdcw	8791-0120	
C16	CAPACITOR, Fixed, ceramic, 560 μμf ±20 per cent, 500 vdcw	8528	
C17	CAPACITOR, Fixed, ceramic, 47 μμf ±5 per cent, 500 vdcw	8769-0470	MIL CC20UJ470J
C18	CAPACITOR, Fixed, ceramic, 8 μμf ±0.25 μμf, 500 vdcw	8791-9801	
C19	CAPACITOR, Fixed, same as C16		
C20	CAPACITOR, Fixed, same as C15		
C21	CAPACITOR, Fixed, same as C4		
C22	CAPACITOR, Fixed, mica, 1000 μμf ±10 per cent, 500 vdcw	14145	ERC 370FA1000
C23	CAPACITOR, Fixed, ceramic, 9 μμf ±0.25 μμf, 500 vdcw	8791-9901	
C24	CAPACITOR, Fixed, same as C4		
C25	CAPACITOR, Fixed, same as C4		
C26	CAPACITOR, Fixed, same as C4		
C27	CAPACITOR, Fixed, same as C4		
C28	CAPACITOR, Fixed, same as C4		
C29	CAPACITOR, Fixed, same as C4		
C30	CAPACITOR, Fixed, same as C4		
C31	CAPACITOR, Fixed, same as C4		
C32	CAPACITOR, Fixed, same as C4		
C33	CAPACITOR, Fixed, same as C4		
J4	CONNECTOR, Receptacle, electrical	11338	MIL UG-290A/U
L1	COIL	22969	
L2	COIL	22968	
L3	COIL, Same as L2		
L4	COIL	22959	
L5	COIL	22960	
L6	CHOKE, RF, 1 μh ±20 per cent	8877-9101	JFE 10100-630

[1] Reference designations are abbreviated; for complete identification, prefix with applicable assembly designation.

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
L7	COIL	22961	
L8	COIL	22967	
L9	CHOKE, RF, 0.22 μh ±20 per cent	8877-9222	JFE 10100-622
L10	CHOKE, RF, same as L9		
L11	CHOKE, RF, same as L9		
L12	CHOKE, RF, 15 μh ±10 per cent	8877-0150	JFE 10102-636
L13	CHOKE, RF, same as L12		
R1	RESISTOR, Fixed, comp, 100,000 ohms ±10 per cent, 1/4w	200-0104	AB CB1041
R2	RESISTOR, Fixed, comp, 150 ohms ±10 per cent, 1/4w	200-0151	AB CB1511
R3	RESISTOR, Fixed, comp, 10,000 ohms ±10 per cent, 1/4w	200-0103	AB CB1031
R4	RESISTOR, Fixed, comp, 4700 ohms ±10 per cent, 1/4w	200-0472	AB CB4721
R5	RESISTOR, Fixed, same as R1		
R6	RESISTOR, Fixed, comp, 2.2 megohms ±10 per cent, 1/4w	200-0225	AB CB2251
R7	RESISTOR, Fixed, comp, 470 ohms ±10 per cent, 1/4w	200-0471	AB CB4711
R8	RESISTOR, Fixed, comp, 220,000 ohms ±10 per cent, 1/4w	200-0224	AB CB2241
R9	RESISTOR, Fixed, comp, 2200 ohms ±10 per cent, 1/4w	200-0222	AB CB2221
R10	RESISTOR, Fixed, same as R4		
R11	RESISTOR, Fixed, same as R2		
R12	RESISTOR, Fixed, same as R2		
R13	RESISTOR, Fixed, same as R4		
R14	RESISTOR, Fixed, same as R1		
R15	RESISTOR, Fixed, same as R4		
R16	RESISTOR, Fixed, same as R3		
R17	(Not used.)		
R18	RESISTOR, Fixed, comp, 3300 ohms ±10 per cent, 1/4w	200-0332	AB CB3321
R19	RESISTOR, Fixed, same as R4		
R20	RESISTOR, Fixed, comp, 390 ohms ±5 per cent, 2w	203-0391	AB HB3915
V1	ELECTRON TUBE, Type 5899	700-0132	
V2	ELECTRON TUBE, same as V1		
V3	ELECTRON TUBE, Type 6021	700-0136	
V4	ELECTRON TUBE, Type 5718	700-0122	
	A2, FIRST I-F ASSEMBLY, ARC-22332		
C1	CAPACITOR, Fixed, ceramic, 0.001 μf ±20 per cent, 500 vdcw	8625-9104	AB 16-102W
C2	CAPACITOR, Fixed, same as C1		
C3	CAPACITOR, Fixed, electrolytic, 0.1 μf ±20 per cent, 35 vdcw	21485-9102	SPR 150D104X0035A2
C4	CAPACITOR, Fixed, electrolytic, 1 μf ±20 per cent, 35 vdcw	21485-9101	SPR 150D105X0035A2
C5	CAPACITOR, Fixed, ceramic, 0.022 μf ±20 per cent, 500 vdcw	8627-9223	AB 40-223W
C6	CAPACITOR, Fixed, ceramic, 5 μμf ±0.25 μμf, 500 vdcw	8791-9501	
C7	CAPACITOR, Fixed, mica, 15 μμf ±5 per cent, 500 vdcw	8870-0150	EMM VTDM15-15
K1	RELAY, Armature, 17V	22583-0170	

[1] Reference designations are abbreviated; for complete identification, prefix with applicable assembly designation.

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
Q1	TRANSISTOR, Type 2N384	22636	
Q2	TRANSISTOR, Same as Q1		
R1	RESISTOR, Fixed, comp, 120 ohms ±10 per cent, 1/4w	200-0121	AB CB1211
R2	RESISTOR, Fixed, comp, 2200 ohms ±10 per cent, 1/4w	200-0222	AB CB2221
R3	RESISTOR, Fixed, comp, 1000 ohms ±10 per cent, 1/4w	200-0102	AB CB1021
R4	RESISTOR, Fixed, same as R2		
R5	RESISTOR, Fixed, comp, 47 ohms ±10 per cent, 1/4w	200-0470	AB CB4701
R6	RESISTOR, Fixed, comp, 470 ohms ±10 per cent, 1/4w	200-0471	AB CB4711
R7	RESISTOR, Fixed, same as R3		
V1	ELECTRON TUBE, Type 5899	700-0132	
Y1	CRYSTAL, Quartz, 28.3 mc	19658-2830	
Y2	CRYSTAL, Quartz, 31.4 mc	19658-3140	
Z1	FILTER, IF	22790	
Z2	FILTER, IF	22788	
Z3	FILTER, Oscillator	22789	
Z4	FILTER, IF	21962	
	A3, SECOND I-F ASSEMBLY, ARC-22327		
C1	CAPACITOR, Fixed, electrolytic, 1 μf ±20 per cent, 35 vdcw	21485-9101	SPR 150D105X0035A2
C2	CAPACITOR, Fixed, same as C1		
C3	CAPACITOR, Fixed, same as C1		
C4	CAPACITOR, Fixed, ceramic, 0.001 μf ±20 per cent, 500 vdcw	8625-9104	AB 16-102W
C5	CAPACITOR, Fixed, same as C1		
C6	CAPACITOR, Fixed, same as C1		
C7	CAPACITOR, Fixed, mica, 68 μμf ±5 per cent, 500 vdcw	8870-0680	EMM VTDM-15-68
C8	CAPACITOR, Fixed, ceramic, 0.01 μf ±20 per cent, 500 vdcw	8627-9103	AB 40-103W
C9	CAPACITOR, Fixed, same as C1		
C10	CAPACITOR, Fixed, same as C1		
C11	CAPACITOR, Fixed, mica, 100 μμf ±5 per cent, 500 vdcw	8870-0101	EMM VTDM-15-100
C12	CAPACITOR, Fixed, mica, 510 μμf ±5 per cent, 300 vdcw	8929-0511	EMM VTDM-15-510
C13	CAPACITOR, Fixed, mica, 220 μμf ±5 per cent, 500 vdcw	8870-0221	EMM VTDM-15-220
C14	CAPACITOR, Fixed, same as C11		
L1	CHOKE, RF, 68 μh ±10 per cent	8922-0680	DECN 3500-04
L2	COIL, 100 μh ±5 per cent	22373	
L3	CHOKE, RF, 150 μh ±10 per cent	8922-0151	DECN 3500-12
Q1	TRANSISTOR, Type 2N274	22541	
Q2	TRANSISTOR, Same as Q1		
Q3	TRANSISTOR, Same as Q1		
Q4	TRANSISTOR, Same as Q1		
R1	RESISTOR, Fixed, comp, 3900 ohms ±10 per cent, 1/4w	200-0392	AB CB3921

[1] Reference designations are abbreviated; for complete identification, prefix with applicable assembly designation.

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
R2	RESISTOR, Fixed, comp, 100 ohms ±10 per cent, 1/4w	200-0101	AB CB1011
R3	RESISTOR, Fixed, comp, 2200 ohms ±10 per cent, 1/4w	200-0222	AB CB2221
R4	RESISTOR, Fixed, comp, 470 ohms ±10 per cent, 1/4w	200-0471	AB CB4711
R5	RESISTOR, Fixed, comp, 33 ohms ±10 per cent, 1/4w	204-0330	GBR 997CX33
R6	RESISTOR, Thermal, 470 ohms ±10 per cent, 1/8w	8944-0471	TI TM1/8-471K
R7	RESISTOR, Fixed, comp, 4700 ohms ±10 per cent, 1/4w	200-0472	AB CB4721
R8	RESISTOR, Fixed, same as R7		
R9	RESISTOR, Fixed, same as R4		
R10	RESISTOR, Fixed, same as R4		
R11	RESISTOR, Fixed, same as R5		
R12	RESISTOR, Fixed, comp, 1000 ohms ±10 per cent, 1/4w	200-0102	AB CB1021
R13	RESISTOR, Fixed, comp, 220 ohms ±10 per cent, 1/4w	200-0221	AB CB2211
R14	RESISTOR, Fixed, same as R13		
R15	RESISTOR, Fixed, comp, 1500 ohms ±10 per cent, 1/4w	200-0152	AB CB1521
R16	RESISTOR, Fixed, same as R13		
Z1	FILTER, IF	21994	
	A4, AUDIO AND AGC MODULE ASSEMBLY, ARC-22230		
C1	CAPACITOR, Fixed, electrolytic, 1 μf ±20 per cent, 35 vdcw	21485-9101	SPR 150D105X0035A2
C2	CAPACITOR, Fixed, same as C1		
C3	CAPACITOR, Fixed, electrolytic, 47 μf ±20 per cent, 20 vdcw	8914-0470	SPR 150D476X0020R2
C4	CAPACITOR, Fixed, same as C1		
C5	CAPACITOR, Fixed, electrolytic, 60 μf ±20 per cent, 6 vdcw	8918-0600	SPR 150D606X0006B1
C6	CAPACITOR, Fixed, same as C1		
C7	CAPACITOR, Fixed, electrolytic, 10 μf +50 -15 per cent, 25 vdcw	8881-0100	FML PP10B25A2
CR1	SEMICONDUCTOR DEVICE, Diode, type 1N462	17633	
L1	CHOKE, RF, 100 μh ±10 per cent	8922-0101	DECN 3500-8
L2	CHOKE, RF, same as L1		
Q1	TRANSISTOR	20638	TI 2N1150/904
Q2	TRANSISTOR, Same as Q1		
Q3	TRANSISTOR, Type 2N274	22541	
Q4	TRANSISTOR	18573	TI 951
Q5	TRANSISTOR, Type 2N375	22289	
R1	RESISTOR, Variable, comp, 100 ohms ±20 per cent, 0.33w	8915-0101	AB GLU1012SD3028L
R2	RESISTOR, Fixed, comp, 1000 ohms ±5 per cent, 1w	202-0102	AB GB1025
R3	RESISTOR, Fixed, comp, 33,000 ohms ±10 per cent, 1/4w	200-0333	AB CB3331
R4	RESISTOR, Fixed, comp, 3300 ohms ±10 per cent, 1/4w	200-0332	AB CB3321

[1] Reference designations are abbreviated; for complete identification, prefix with applicable assembly designation.

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
R5	RESISTOR, Fixed, comp, 15,000 ohms ±10 per cent, 1/4w	200-0153	AB CB1531
R6	RESISTOR, Fixed, comp, 100,000 ohms ±10 per cent, 1/4w	200-0104	AB CB1041
R7	RESISTOR, Thermal, 1000 ohms ±10 per cent, 1/8w	8944-0102	TI TM1/8-102K
R8	RESISTOR, Fixed, comp, 1000 ohms ±10 per cent, 1/4w	200-0102	AB CB1021
R9	RESISTOR, Fixed, comp, 2200 ohms ±10 per cent, 1/4w	200-0222	AB CB2221
R10	RESISTOR, Fixed, same as R8		
R11	RESISTOR, Fixed, comp, 1500 ohms ±10 per cent, 1/4w	200-0152	AB CB1521
R12	RESISTOR, Fixed, comp, value between 1000 ohms and 1500 ohms selected at time of final adjustment	200- [2]	AB CB
R13	RESISTOR, Fixed, comp, 100 ohms ±10 per cent, 1/4w	200-0101	AB CB1011
R14	RESISTOR, Fixed, comp, 220 ohms ±10 per cent, 1/4w	200-0221	AB CB2211
R15	RESISTOR, Fixed, comp, 47,000 ohms ±10 per cent, 1/4w	200-0473	AB CB4731
R16	RESISTOR, Fixed, comp, 22 ohms ±5 per cent, 1w	202-0220	AB GB2205
R17	RESISTOR, Thermal, 180 ohms ±10 per cent, 1/8w	8944-0181	TI TM1/8-181K
R18	RESISTOR, Fixed, comp, value between 47 ohms and 3300 ohms selected at time of final adjustment	200- [2]	AB CB
	A5, METER MODULE ASSEMBLY, ARC-22348		
R1	RESISTOR, Variable, comp, 10,000 ohms ±20 per cent, 0.33w	8915-0103	AB GLU1032SD3028L
R2	RESISTOR, Variable, same as R1		
T1	TRANSFORMER, Audio output	21991	
Z1	FILTER, Bandpass	21388	UNT X8448
Z2	FILTER, Bandpass	21389	UNT X8449
Z3	BRIDGE CIRCUIT ASSEMBLY	19408	
	A6, CHANNEL SELECTOR ASSEMBLY, ARC-22732		
B1	MOTOR, DC, 14V	18800	CLIP DC-8-C-51
B1	MOTOR, DC, 28V	18801	CLIP DC-8-C-11
K1	RELAY, Armature (used in 14V unit)	22584-0014	GE 3S2791G200A6
K1	RELAY, Armature (used in 28V unit)	22584-0028	GE 3S2791G200A9
K2	RELAY, Armature (used in 14V unit)	22584-0014	GE 3S2791G200A6
K2	RELAY, Armature (used in 28V unit)	22584-0028	GE 3S2791G200A9
	For mechanical parts, see Figure 5-1.		
	A7, POWER SUPPLY ASSEMBLY, ARC-22733-0014 or ARC-22733-0028		
C1	CAPACITOR, Fixed, electrolytic, 1 μf ±20 per cent, 35 vdcw	21485-9101	SPR 150D105X0035A2
C2	CAPACITOR, Fixed, same as C1		
C3	CAPACITOR, Fixed, electrolytic, 12 μf +75 -15 per cent, 150 vdcw	24420	SPR 112D126C7150J0

[1] Reference designations are abbreviated; for complete identification, prefix with applicable assembly designation.
[2] To complete part number, add resistance value in ohms.

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
C4	CAPACITOR, Fixed, electrolytic, 47 μf ±20 per cent, 50 vdcw	8924-0470	SPR 109D476X0050F2
C5	CAPACITOR, Fixed, ceramic, 0.022 μf ±20 per cent, 500 vdcw	8627-9223	AB 40-223W
CR1	SEMICONDUCTOR DEVICE, Diode, type 1N2071	8931-0601	
CR2	SEMICONDUCTOR DEVICE, same as CR1		
CR3	SEMICONDUCTOR DEVICE, Diode, type 1N1358RA	8934-0200	
CR4	SEMICONDUCTOR DEVICE, Diode, type 1N1351A	8923-0100	
L1	REACTOR, 1.2 mh	21429	CMPB L2254
L2	REACTOR, 1.5 h	18328	CMPB L1688
Q1	TRANSISTOR, Type 2N375	22289	
Q2	TRANSISTOR, Same as Q1		
R1	RESISTOR, Fixed, comp, 100 ohms ±10 per cent, 1/4w (used in 14V model)	200-0101	AB CB1011
R1	RESISTOR, Fixed, comp, 220 ohms ±10 per cent, 1/4w (used in 28V model)	200-0221	AB CB2211
R2	RESISTOR, Fixed, comp, 4700 ohms ±5 per cent, 1/2w (used in 14V model)	201-0472	AB EB4725
R2	RESISTOR, Fixed, comp, 15,000 ohms ±5 per cent, 1/2w (used in 28V model)	201-0153	AB EB1535
R3	RESISTOR, Fixed, same as R2 (14V and 28V models)		
R4	RESISTOR, Fixed, same as R1 (14V and 28V models)		
R5	RESISTOR, Fixed, ww, 12 ohms ±3 per cent, 3w (used in 14V model)	209-0120	DABU RS2-120H
R5	RESISTOR, Fixed, ww, 150 ohms ±3 per cent, 3w (used in 28V model)	209-0151	DABU RS2-151H
R6	RESISTOR, Fixed, ww, 3 ohms ±3 per cent, 3w (used in 28V model only)	209-9301	DABU RS2-3R0H
R7	RESISTOR, Fixed, comp, 22,000 ohms ±5 per cent, 1w	202-0223	AB GB2235
T1	TRANSFORMER (used in 14V model)	22491	
T1	TRANSFORMER (used in 28V model)	22493	
	A8, MAIN CHASSIS ASSEMBLY		
C1	CAPACITOR, Fixed, ceramic, 1000 μμf ±20 per cent, 500 vdcw	8832	SLM CF-100-2-102Z
C2	CAPACITOR, Fixed, same as C1		
C3	CAPACITOR, Fixed, same as C1		
C4	CAPACITOR, Fixed, same as C1		
C5	CAPACITOR, Fixed, same as C1		
C6	CAPACITOR, Fixed, same as C1		
C7	CAPACITOR, Fixed, same as C1		
C8	CAPACITOR, Fixed, same as C1		
C9	CAPACITOR, Fixed, same as C1		
C10	CAPACITOR, Fixed, same as C1		
C11	CAPACITOR, Fixed, same as C1		
C12	CAPACITOR, Fixed, same as C1		
C13	CAPACITOR, Fixed, same as C1		
C14	CAPACITOR, Fixed, same as C1		
C15	CAPACITOR, Fixed, same as C1		
C16	CAPACITOR, Fixed, same as C1		
C17	CAPACITOR, Fixed, same as C1		

[1] Reference designations are abbreviated; for complete identification, prefix with applicable assembly designation.

Reference Designation[1]	Description	ARC Part No.	Manufacturer & Part No.
J1	CONNECTOR, Receptacle, electrical	19317	
J2	CONNECTOR, Receptacle, electrical	21984	AMP 94-42530
J3	CONNECTOR, Receptacle, electrical	19316	
S1	SWITCH ASSEMBLY	22845	
W1	CABLE ASSEMBLY	24623	
Y1	CRYSTAL, Quartz, 49.933 mc	19658-4993	
Y2	CRYSTAL, Quartz, 50.033 mc	19658-5003	
Y3	CRYSTAL, Quartz, 50.133 mc	19658-5013	
Y4	CRYSTAL, Quartz, 50.233 mc	19658-5023	
Y5	CRYSTAL, Quartz, 50.333 mc	19658-5033	
Y6	CRYSTAL, Quartz, 50.433 mc	19658-5043	
Y7	CRYSTAL, Quartz, 50.533 mc	19658-5053	
Y8	CRYSTAL, Quartz, 50.633 mc	19658-5063	
Y9	CRYSTAL, Quartz, 50.733 mc	19658-5073	
Y10	CRYSTAL, Quartz, 50.833 mc	19658-5083	
	CONTROL UNIT ASSEMBLY, ARC-21700		
DS501	LAMP, Incandescent, T-1-3/4 bulb, midget flange base, 14V, 0.08 amp (used on 14V models only)	8679	GE 330
DS501	LAMP, Incandescent, T-1-3/4 bulb, midget flange base, 28V, 0.04 amp (used on 28V models only)	8622	GE 327
DS502	LAMP, Incandescent, same as DS501 (14V or 28V lamps)		
DS503	LAMP, Incandescent, same as DS501 (14V or 28V lamps)		
DS504	LAMP, Incandescent, same as DS501 (14V or 28V lamps)		
J501	CONNECTOR, Receptacle, electrical	12096	
S501	SWITCH, Rotary, 2 sections, 24 positions	21703	OAK 95765-MF-2
S502	SWITCH, Toggle, spst, 3 amp, 250V	8084	CUT 8908K142
XDS501	LIGHT ASSEMBLY, Panel	16293	GMC A5890
XDS502	LIGHT ASSEMBLY, Panel, same as XDS501		
XDS503	LIGHT ASSEMBLY, Panel, same as XDS501		
XDS504	LIGHT ASSEMBLY, Panel, same as XDS501		

[1] Reference designations are abbreviated; for complete identification; prefix with applicable assembly designation.

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